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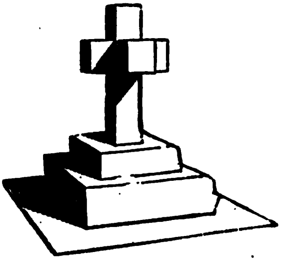
INTRODUCTION.

In the course of twenty years' extensive practice as a teacher of drawing, the Author has frequently had considerable difficulty in making his juvenile pupils comprehend the necessity for and the value of a knowledge of Perspective. Many works have appeared, proposing to enable the student and the amateur to instruct themselves in this indispensable branch of the Art of Painting; but the Author has never yet met with one that has appeared to him well calculated to accomplish so desirable an end. To furnish amateurs, and especially young ladies, with the means to acquire, by themselves, a knowledge of Perspective, sufficient to enable them to make agreeable sketches from nature, without sacrificing too much of the time that must be required for other occupations, has been the object of the Author. In the little work he now puts before the public, his principal endeavour has been to avoid every possible difficulty—every superfluous line. It is addressed to those who require a simple and comprehensive knowledge of Perspective, to enable them to avoid committing any of those gross errors so constantly to be observed in the works of those entirely ignorant of it. He strongly advises all desirous of drawing from nature to make themselves masters of the modes here given for drawing various forms, so as to be able to apply them mentally in sketching from nature. It is universally admitted that sketches made by those who draw by their eye, having at the same time a thorough knowledge of Perspective, produce more agreeable paintings than those who draw entirely by rule. To demonstrate to the juvenile student the value of a knowledge of Perspective, let him examine the cut at the end of this Introduction, as also that at the end of the First Part. The first is a correct representation of a double cross in perspective, drawn, as it would appear, when quite new and perfect; the latter (which is drawn over the same outline) is intended to represent a similar cross in an ancient and dilapidated state. The student will perceive that the perspective drawing looks formal and uninteresting, while the other has an agreeable and picturesque appearance, though perfectly correct. The Art of Painting is to represent objects in nature as they appear to the eye; but if any lines, either from time or accident, have lost their perpendicular or horizontal direction, great care should be taken in the representation of them, that they are so drawn as not to appear like faulty Perspective, but as the result of time or some other cause. It is the absence of formality that constitutes picturesque form.

The Second Part, which is entirely new, and written for this Edition, carries the student still further, and opens to view all the requisite acquirements for a perfect knowledge of the Art of Perspective. This edition will be found to comprehend all the principles, with simple representations, to enable the learner by ordinary application to execute perspective drawings with facility.



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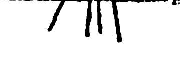
PERSPECTIVE FOR STUDENTS.

CHAPTER I.

STUDENTS, from the first commencement of drawing, should never neglect an opportunity of submitting their productions to the inspection of those who, from their superior knowledge, may point out defects, and suggest alterations extremely useful. But in criticising their works, those who have attained some proficiency may frequently make use of terms which, though perfectly correct, may by possibility not be understood by very young pupils, and hence they may lose much valuable assistance.

Before commencing Perspective, the pupil will therefore find it to his advantage to make himself acquainted with the following preliminary matters, which more properly belong to practical geometry. Many young persons, in copying a drawing, if they draw a line that is out of the perpendicular, or not horizontal, are apt to say, "That line is not straight." The first thing to comprehend is, that all lines lying evenly between their two extremities (which are called points) are straight lines, whatever direction they may take (Fig. 1). The line A B is a straight line, and each of the lines that run from it, and through it are also straight lines, although they vary in their direction.

Fig. 1.



Lines that run in the same direction, and continue always at the same distance from each other, are called parallel lines (Fig. 2). Lines which incline towards each other and meet in a point, are said to form angles. Angles have three different names, according to the space contained between the two lines at an equal distance from their point of meeting (Fig. 3). The lines A E and C E meet together at the point E; the lines B E and C E also meet together at the point E: the space between A C and the space between B C will be found to be exactly equal. Whenever one line stands upon another line, and, upon drawing a semicircle from the point of contact (as the semicircle A C B, drawn from the point E), the line divides the semicircle into two equal parts, it is said to be perpendicular* to the line on which it rests, and the angle on either side is called a right angle. If the space contained between two lines forming an angle be less than that contained between the lines forming a right angle, the two lines are said to form an acute angle. The angle formed by the lines D E and A E is less than the right angle, because the space contained between A D is less than the space contained between C A: for the same reason, the lines C E and D E also form an acute angle. If the space contained between the two lines be greater than the space contained between the two lines that form the right angle,

Fig. 2.

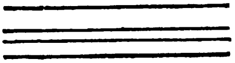
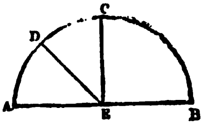


Fig. 3.



* It is a common error to confound the terms vertical and perpendicular. One line is always said to be perpendicular to another line when the angle formed by the two lines is a right angle. Vertical lines are those lines perpendicular to the horizon, or to the surface of the globe. If a vessel lie on the surface of the water in a dead calm, having her masts perpendicular to her deck, the masts may be said to be vertical; but if the water were agitated so as to throw the vessel at an angle with the horizon, though the masts would still be perpendicular to the deck they would no longer be vertical lines.

the two lines are said to form an obtuse angle. The angle formed by the lines B E and D E is greater than the right angle, because the space contained between B D is larger than the space contained between B C. If the learner open a pair of compasses exactly half way, the legs of the compasses will form a right angle; if they are shut-to a little, they then form an acute angle; if opened a little wider, they form an obtuse angle. If the extremities of the two lines forming an angle are joined by a third line, the figure formed by the three lines is called a triangle, from its containing three angles (Fig. 4).

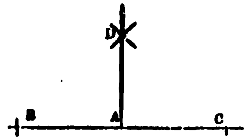
Fig. 4.

In making perspective drawings, certain instruments are indispensable; and one of the most essential is a proper drawing-board, in the choice of which great care should be taken that the edge at the bottom be perfectly straight, and that at all events one of the sides be perfectly at a right angle with the line of the bottom—or, in other words, that the side of the board be perpendicular to the bottom: if not, and the pupil should make use of the T square,* his drawing can never be correct; because all lines drawn with the T square are parallel: consequently, whatever error may exist in the drawing-board will be multiplied by your ruler. To be certain that you commence with a perpendicular line, draw, as in the following example

---

* The tee, or, as it is commonly written, from its form, T square, is a ruler to which is attached at one end a cross piece of wood; and this cross piece, being made thicker than the ruler itself, enables the draftsman to slide it backwards and forwards on the edge of his board. The ruler attached to this cross piece is exactly at right angles with it; and consequently, in moving it along the bottom edge of the board, and drawing lines from it, the lines must all be parallel to each other, and perpendicular to the bottom line of the board. Now if the drawing-board have one of its sides at a right angle with the bottom edge, by shifting the T square from the bottom to the side of the board, and sliding it on this edge, all the lines ruled from it will be parallel to each other, and at right angles with the lines drawn from the bottom. The T square is the most convenient and quickest ruler for drawing all perpendicular and horizontal lines.

Fig. 5.



(Fig. 5), with a ruler a straight line, which is to form the bottom or base line of your picture. From the point on this line from which your perpendicular line is to be raised, as at A, mark off an equal space on each side, as the spaces A B and A C; from the extremity of each of these spaces, at the points B and C, with a pair of compasses, at an extension of not less than once-and-a-half the length of A B or A C, describe two portions or arcs of a circle immediately over the point A; from the point D, where these two arcs intersect each other, draw the line D A, which will always be perpendicular to the line A B, and may be continued to any length. The learner must be aware that in a work of this kind, illustrated by woodcuts, the space for the insertion of the examples is extremely limited; he is therefore recommended, in drawing them for his own practice and improvement, to enlarge them very considerably—say from four to six times the size.

There are various other rules in practical geometry that the author has found useful to his pupils; but as this is not a treatise on practical geometry, they are not given. The foregoing are introduced from a conviction that with the very young, they are nearly, if not quite, indispensable.

In introducing my young readers to an elementary knowledge of perspective, as the most simple definition, I should say that perspective is the art of representing objects at various distances, and is of two kinds—Aërial Perspective, and Linear Perspective. Aërial Perspective is the art of giving the appearance of distance, independent of lines. Claude de Lorraine is celebrated for his exquisite manner of representing aërial perspective: many English painters are also highly and deservedly celebrated for this portion of the art of painting, more particularly the painters in water-colours; among whom, perhaps, Glover and Copley Fielding have been the most successful. It is of the latter, Linear

Perspective, that we have to treat: of this it may be said, that it is the art of drawing outlines of objects from nature, of their relative sizes according to their distance, and of their apparent variety of form according to their position, as they would appear in looking through a sheet of glass placed between them and the spectator. The reader is doubtless aware that all objects of the same magnitude apparently diminish as they recede from the eye of the spectator. In walking in a long street at night, the reader must have noticed the appearance of the gas lamps as they gradually recede from him: if the street be very long, they will appear to come closer and closer together. till they apparently meet in a point;* yet the more distant lamps are as far apart from each other as those close to the spectator. The same appearance is observable in a long avenue of trees. In a long series of arches, the first few will show their curves wide and distinct: as they recede from the eye they appear gradually narrower and narrower, till in the extreme distance they assume the appearance of mere straight lines. To demonstrate clearly to the young reader that objects at a great distance seem very small, let him look through a pane of glass, and imagine that this pane of glass were a sheet of paper, on which he had to represent all the objects he sees through it: though this pane of glass may only be a foot square, he may see houses, ships, tracts of country, mountains, rivers, &c. &c. represented on this small space, though perfectly aware of their actual size.

Most of my readers must have heard the term *horizon* frequently used in conversation—in such cases as "the sun is above the horizon," or, "the sun has sunk below the horizon," &c. &c. Every perspective drawing has a line running across it, parallel to the bottom of the picture, to designate the line of the horizon, which line is called the horizontal line. In drawing from nature, this line is at a height exactly level with the eye of the draftsman; and its position, or distance from the base of the picture, which is called the ground line, depends entirely on the position in which the artist places himself to take his sketch. In the following example (Fig. 6), we will suppose the lines 1, 2, 3, 4, to form the boundary lines of the picture. If the draftsman is placed in a sitting posture, as at A, the horizontal line will be at the height of the line 5, even with the painter's eye, and parallel to the ground line 1. If the draftsman stand up to take his sketch, as at B, the horizontal line will be higher, in consequence of his eyes being in a more elevated situation, and will be at the line 6. If, to get into his picture some more distant object, the artist should find it necessary to raise himself still higher, as at C, upon the bank, the horizontal line will also be raised, as seen by the line 7; or, as I have before stated, the height of the horizontal line depends on the raised or lowered position of the eye of the artist.

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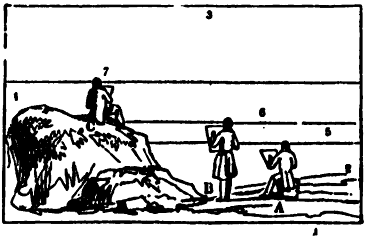
* This point is termed the vanishing point, and is most important, as will be seen in our progress.

Fig. 6.



In making a picture, the choice of height of the horizontal line is of considerable importance. To make the horizontal line exactly half-way between the top and bottom of the picture, has generally a bad effect; it appears to cut the picture in half, and the perspective is not pleasing to the eye. It is generally considered that the most agreeable perspective is produced by placing the horizontal line at about one-third the height of the picture from the ground-line: to place it lower than this is generally preferable to placing it higher. There are painters, however, of great celebrity, who in some of their finest productions have placed their horizon so high as to be removed only one-third from the top of the picture. Gaspard Poussin, Francesca Mola, Domenichino, &c. have frequently painted pictures with these high horizons; but the subjects are peculiar, and the painters so talented, that anything emanating from their pencils cannot fail to be good. All those views that come under the denomination of bird's-eye views must necessarily have the horizontal line very high, being taken always from some high window, tower, or eminence of some sort, such as the views of London from St. Paul's, of Paris from the Pantheon, &c. &c.; but such views are intended more for topographical curiosities than for pictorial representations.

In order to give the reader an idea of the use of perspective, we will commence with some object of the most simple form, a square, or oblong (figures which are technically called rectangular parallelograms, from their opposite sides being parallel to each other, and the angles all right angles). Let the student take any rectangular object—a workbox, for instance; let him place it in front of him, close to his feet, then bend his head slightly forward till his eyes come immediately over the centre of the box (Fig. 7): so placed, he will be able to see nothing but the simple form of the lid, it being impossible in this position to see either the front, back, or sides. Let the student now place the box on the chimney-piece, the front towards him, and place himself about two yards from it, and in such a position that his eyes shall come on a level with the middle of the front of the box, and exactly midway between its two sides (Fig. 8): thus placed, the student will see nothing but the front of the box, it being impossible in this position to see either the top or sides. The student must now place the box on a chair, or other support, so as to be in height about halfway between his head and feet, placing himself at two or three yards' distance from the object, but still in such a position as to stand exactly opposite the keyhole of the box (Fig. 9): he now, from the changed position, sees the top and front of the

Fig. 7.

Fig. 8.

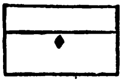
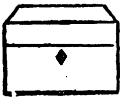
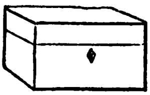


Fig. 9.



box. Let the student now shift his position about one yard to the left, leaving the box in the same situation; he will here find that he sees the front, the top, and one side of the box (Fig. 10). The student will here observe, that according to the variation of the position from which he regards the object, it changes its apparent form. In the first two figures he will see that the lines are all parallel to their opposites, or, as it is commonly called, are in geometrical drawing; but in the third figure he will perceive that the lines of the sides of the top converge, and that the line of the top of the box at the back is shorter than the line of the top in front. Perspective teaches how to find the proper directions for these converging lines, and also shows how to regulate the length of the line at the back of the box, so as to make it agree with its apparent diminution of size to the visual organs. The same remarks apply equally to the last figure.

Fig. 10.



As another example of the use of perspective, let the student procure a common bowl, and place it at his feet, looking at it in a similar manner as at the workbox in its first situation. In looking at it in this position, the student will see nothing to draw but a plain circle (Fig. 11). If the bowl be placed on a chair, as the workbox in its third situation, the spectator being in the same relative position, the circular opening of the bowl appears of only half its width, and a portion of its outer part is seen (Fig. 12). If the bowl be now placed on the chimney-piece, and the eye of the spectator brought to a level with the upper edge of the bowl, none of the inside of the bowl is perceptible, the circle from this point of view appearing as a straight line (Fig. 13). The student will here observe that, according to the position in which the spectator is placed relatively to a circular object, it takes the

Fig. 11.

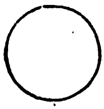


Fig. 12.

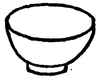
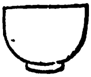


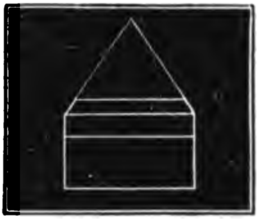
Fig. 13.



form of a circle, an ellipse, or a straight line. Perspective teaches how to delineate the form the circle apparently assumes, according to the point of view from which it is seen.

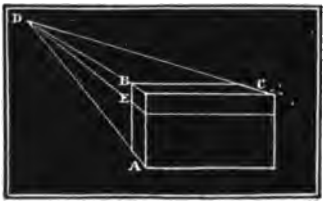
In the preceding pages we have introduced four diagrams, representing the change of appearance a work-box, or any similar object, assumes, as viewed from four different positions. In the first and second figures, the upper and lower lines of the box are parallel, as are the upright lines representing the sides; they are in fact of precisely the same form as that they are intended to represent, the position in which they are viewed presenting the simple geometrical figure. The third position of the box presents the front, similar to the second, but being below the eye, the top as well as the front of it is seen. Now, as objects appear smaller as they are further removed from the spectator, the back of the box will appear less than the front, and must necessarily be represented by a shorter line; hence it must be obvious that to draw the lines representing the sides of the top, they must incline towards each other, and if continued, would meet in a point, as in the annexed figure.

Fig. 14.



In the fourth diagram, the front of the box is still drawn geometrically, but from its position being again changed relative to the spectator, both the top and one side of the box, as well as the front, are vissible; and as the lines representing the back of the top and the further angle are both drawn shorter than the front edge and nearer angle of the box, the lines drawn to represent the sides of the top and the side of the bottom must incline towards each other, and the three lines would, if continued, meet in the same point. Now these three lines, which in Figure 15 incline

Fig. 15.



towards each other so as to meet in the same point, in the original object (the workbox) are parallel lines; and herein consists the difference between what is called Geometrical or Elevation drawing, and Perspective drawing. In the former, all lines that are parallel in the original object, are drawn parallel in the representation; whereas in perspective drawing all representations of parallel lines incline towards each other, and tend to the same point. This point is always placed on the horizontal line, and is called the vanishing point. Thus, D in the foregoing figure is the vanishing point for the lines A B C, and would be the point to which all lines which in the original object are parallel to those they represent (the side edges of the box) would be drawn, however numerous; this is exemplified by the line E, showing where the lid of the box shuts on.

It is to be presumed, that before commencing the study of perspective, the student has already dabbled a little in drawing; in which case he must now make an attempt to draw a little perspective for himself. Let him place himself in a chair, immediately opposite a closed door, and at a distance of six to eight feet, and in that position let him draw the door, and the cornice if any; if not let him sketch a little of the pattern of the papering above the door, as in fig. 1, Plate I., which is a geometrical drawing of a door, to be put in perspective.

Let the student now imagine a straight line passing directly from his eye to the door, always at the same height from the floor—or, more correctly speaking, parallel to the floor: this line would touch the door at the point A; and this point fixes the height of the horizontal line, and is called the point of sight.* But we must here proceed with the second figure, Plate I.

The student must first draw the four outer lines of the

---

* The point exactly opposite the eye of the spectator is always termed the point of sight, and forms the *perspective* centre of a picture: when used as a vanishing point, it is for those lines only that are parallel to the imaginary straight line passing from the eye to it.

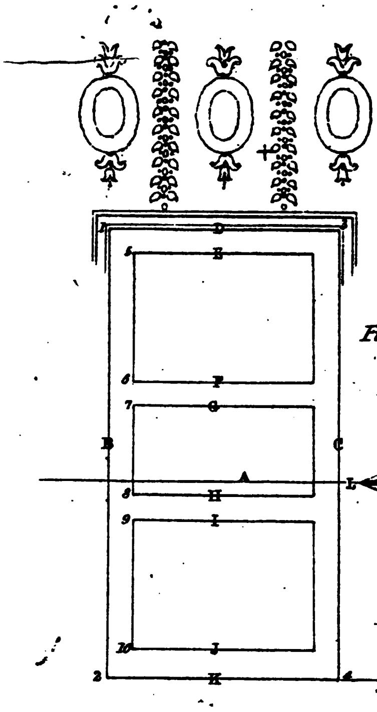


Fig. 1.

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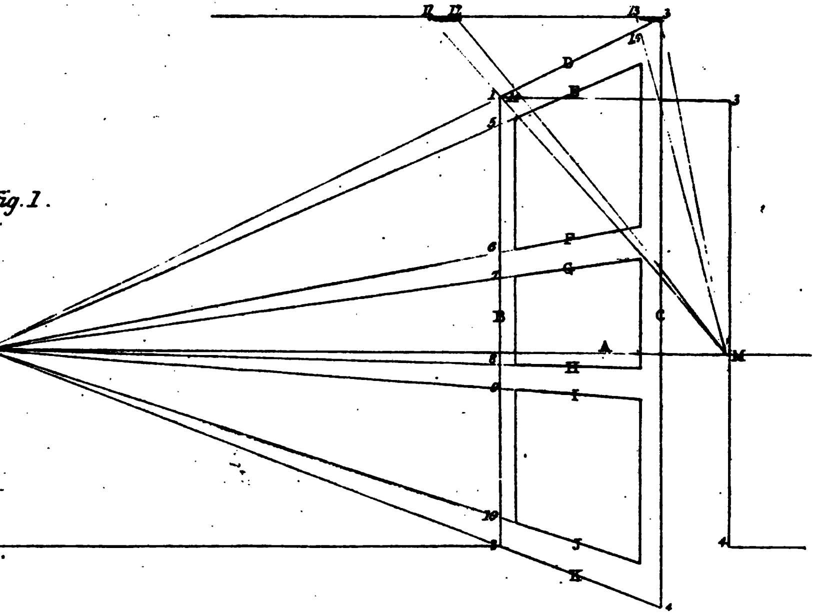

Fig. 2.

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door, B C D K, as in the geometrical drawing, and then through the point A (the height of his eye from the ground) draw a line across his picture parallel to the ground line, or bottom line of the drawing; this is the horizontal line. In looking at the geometrical drawing (fig. 1), it will be seen that the two lines B C, which represent the two sides of the door, from each of them being at the same distance from the eye of the spectator, are of an equal length; that the lines D and K, representing the top and bottom lines of the door, are parallel to each other; and that the lines representing the top and bottom of the panels are parallel to each other, and to the lines D and K also. Let the student now open the door about one foot: here he will observe an extraordinary difference;—the directions of all the horizontal lines,* as seen in the geometrical drawing, are now changed. Observe that the upper and lower corners of the door, 1 and 2, the side where the hinges are fixed, remain the same as in the geometrical drawing: they have not changed their situation but the corner 3 appears raised, and the corner 4 lowered making the side C of the door consequently appear longer; the side of the door C, from its being approached nearer the eye, becomes apparently larger; but the side B, as it remains in precisely the same position, remains of the same size as in the geometrical drawing. The student must now carefully notice at what particular spot on the cornice, or at what particular mark on the pattern of the papering, the point 3, marking the top of the door, appears to touch, and mark the spot on his drawing, as at A: from this point, through the point 1, marking the other corner of the top of the door, the student must draw a line till it touch the horizontal line; and the point L, where it touches, is its vanishing point. Now the student must bear in mind, that this vanishing point is the point to which every line of the door, parallel to the line of the top of the door in the geometrical drawing, must be drawn in his perspective drawing, whether above or below the horizontal line. In order to get the perspective line of the bottom of the door, the student must place his ruler to the vanishing point L, and draw a line through the point 2 till it passes nearly under the right-hand side of the door: to determine the length of this line, the student must draw a perpendicular line from the point 3 till it meets it at the point 4. The student should now, with a firm hand draw over the lines B, C, D, K, to make them stronger than the other lines; and he will then have the external lines of the door in perspective, as it appears to him from the position in which he is placed. The next thing necessary is to find the perspective inclinations of the lines forming the top and the bottom of the panels of the door—the lines E, F, G, H, I, J, of the geometrical drawing. To accomplish this, the student must mark upon the line B the relative distances of these lines, as at the points 5, 6, 7, 8, 9, 10; and from the vanishing point L through each of these points he must draw a line till it touch the line C. Here, then, are all the horizontal lines of the panels of the door in their perspective directions: and the student will observe that the panels of the door, as also the framework of the panels, gradually widen as they approach the eye of the spectator, or, in other words, they diminish as they recede from it. Having obtained the lines which will regulate the height of the panels, it is now necessary to determine their width. It must be obvious to the reader, from what has already been said, that the framework surrounding the panels must be wider on the side nearest to him than on the side at the greater distance. To find the width of the panels, the student must draw a line parallel to the horizontal line from the point 3 of the geometrical length of the top of the door, and measure off with his compasses from each extremity, 3 and 11, a space equal to the width of the framework of the panels, as at 12 and 13, the space between being obviously the width of the panel. From the point 11, passing through the point 1, a line must be drawn till it touch the horizontal line, as at M; and this point is called the point of distance, by which the perspective width of all the spaces between the perpendicular lines upon the door may be ascertained. From the points 12 and 13 two lines must be drawn to the point of distance, M; and where these lines intersect the line D, at 14 and 15, they mark the perspective width of the framework or panels on the top of the door: from these points, 14 and 15, two perpendicular lines must be drawn till they touch the line K; and where these perpendicular lines pass between the lines E and F, G and H, and I and J, they form the perpendicular boundaries of the panels. The student must now strengthen all the lines of the panels, as in the example; and he has completed his task,—he has drawn the door in perspective.

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* All lines in a drawing that are parallel to the horizontal line are called horizontal. The student must understand that the line drawn through the point A is *the* Horizontal Line, or line representing the horizon; and that those lines parallel to it are only called horizontal in reference to their being parallel to it.

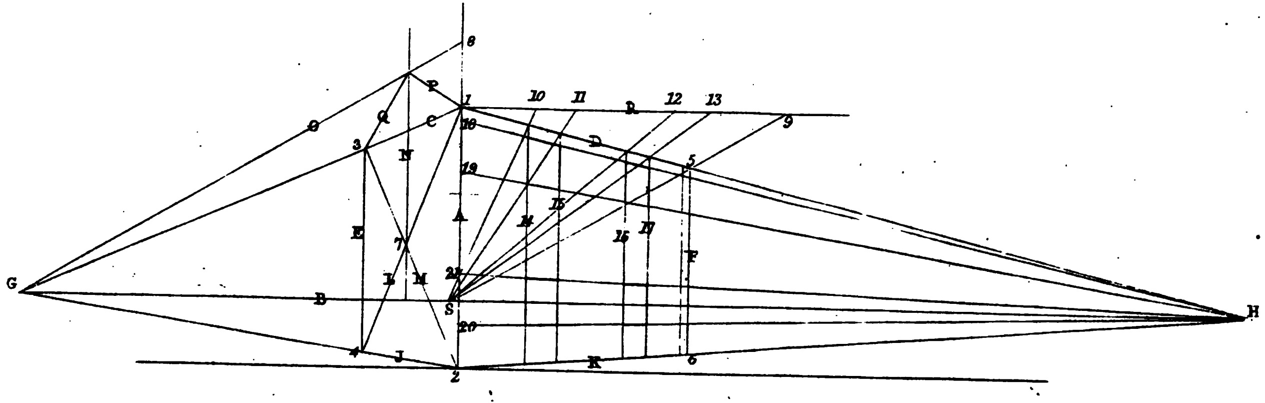
In order to make the foregoing example simple enough to be comprehensible to the most inexperienced, the drawing is confined to the fewest possible quantity of lines. The thickness of the door and the projection of the framework round the panels has been purposely omitted,—a multiplicity of lines tending always to perplex the learner; but the rules for drawing these are the same as those already explained. That the student may satisfy himself that he has clearly understood what he has just accomplished, let him open the door so wide as to bring the handle of the door within a foot of the wall, and reseat himself in the same position. He now loses sight entirely of the side of the door he has just drawn, and the outer side becomes visible. The point of sight, and consequently the horizontal line, is precisely the same, but the vanishing point of the door changes sides: instead of being to the left of the artist, it is now to his right hand; the whole drawing of the door is reversed, but the process of putting it in perspective is precisely similar to that of the last example. It is strongly recommended to the student to proceed carefully and steadily to draw it in this altered position.

CHAPTER II.

The Author, when very young, on being strongly recommended by an artist, now an R.A., to draw from nature, replied that he had no possibility of getting into the country. "My young friend," said Mr. C——, "you have got a notion, like many other foolish people, that to draw from nature it is necessary to go into the country. Let me advise you, if you cannot find a tree to draw from, to draw the plants in your mother's flower-pots; if you cannot get to draw the outside of a house, draw the inside of a room; if you are unable to find a wheelbarrow, take a coal-scuttle; if cows and sheep are not to be found, draw the family cat;—you will find it equally improving, and it will give you the power ultimately of representing every object you desire on paper." The advice was most excellent; and the Author most strongly recommends it to his juvenile readers. He is about to lead them step by step to draw various objects in perspective; and the forms selected will be the most familiar and the best adapted to the purpose: but in the limits of a small work like this the principles on which certain objects may be represented in drawing is all that is attempted. If an example of a square object is given, the rules for drawing that square object will apply to everything of a similar form seen from a similar point of view. If an example is given for drawing a circular, octagonal, or any other form, all similar forms may be drawn by the same rules. Once clearly comprehend how to draw a circle in perspective, and it is immaterial what circular object is to be represented: the same rules apply to all, whether a plate, a tumbler, a column, or a dial, &c.

One of the great difficulties experienced by teachers is that of making their pupils understand the manner of finding the Vanishing Points and Points of Distance. For architectural

Prob. 1.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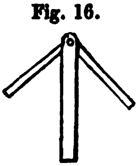
draftsmen, and those who go deeply into perspective, there are rules by which all the various points are to be found; but they are perplexing and tedious, unfitted for an elementary work like this, and unnecessary for those whose object is simply to acquire that knowledge of perspective which will enable them to make correct and agreeable sketches from nature. In order to find the Vanishing Points, some teachers recommend their pupils to make use of an instrument called a moveable angle, or guiding-rule. It is an instrument of this form. (Fig. 16.) It is made simply of three straight pieces of wood, the two outer pieces of which, by means of a moveable screw, open and shut like a pair of compasses. The use of it is, to hold it at arm's length, between the spectator and the object to be represented—as, for instance, the two top lines of a church tower—and, by means of the screw, move the legs of the guiding-rule till they follow the direction of the inclination of these two upper lines; then, laying the guiding-rule on your paper, and placing the point formed by the angle over the point representing the highest point of the nearest corner of the tower, rule the lines in the direction of the two sides of the guiding-rule, and continue them till they touch the horizontal line. The points where these lines would touch would form the vanishing points for the horizontal lines on the respective sides of the tower.

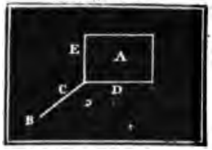
Fig. 16.



Presuming that the reader draws a little before attempting to draw from nature (and if not, he is strongly recommended so to do), the author considers it far preferable for the draftsman to depend rather on his eye and judgment than to make use of a guiding-rule or other mechanical instrument; that he make his first sketch by eye, and correct it afterwards by the rules of perspective.

Problem I.—Let the student imagine himself placed before a cottage, having a gable at one end and four windows in front, and let him further imagine that he is so situated as to see both sides nearly equal—that he stands, in fact, nearly in a line running from the angle formed by the lines J K to the corresponding corner, which is hidden. (Fig. 17.) Suppose A to be the plan of the house, and B the position of the draftsman, C would represent the line drawn from the spectator's eye to the point of sight: and the student will perceive that the lines D and E, the two sides of the house visible, are neither of them in the direction of this line C; consequently, that the point of sight cannot form the vanishing point for any lines running parallel to either D or E; and that as these two lines are also at an angle, each of them must have its respective vanishing point: the line D will have its vanishing point to the right, and the line E to the left.

Fig. 17.



The student, if sketching from nature, must first draw, according to the best of his judgment, the first upright line, A, of the building, and set a mark upon it at the height of his eye, in order to get the horizontal line. To make this perfectly simple, we will suppose the real height of this line to be twenty feet, and that the spectator is so situated as to have his eye at five feet from the ground; he must then measure off from the bottom of the line one-fourth of its length, which will give the height of his eye at five feet from the ground; and through this point he must draw a line, B, across the picture, which will form the horizontal line.*

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* The student must here bear in mind that the height of the horizontal line depends entirely on the situation in which he is placed. If the building from which he is drawing stood on a rising ground, say a rise only of five feet, the horizontal line would be exactly on a line with the base of the building, the spectator's eye being supposed five feet from the ground on which he stands. If, on the contrary, the *spectator* stood on a rise of five feet, the horizontal line would cut the line A in half, because, the house being twenty feet, the spectator's eye, being five feet above the spot on which he stands, would bring it to ten feet high. If the spectator stood on a rise of fifteen feet, the horizontal line would

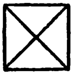
From the top of the line A the student must now sketch the lines C and D, marking their inclination towards the horizontal line as carefully as possible, and he must then sketch the lines E and F, to determine the width of the two sides of the building. This is all that is necessary for the student to draw by eye, and he must now correct his sketch by rule. He must first, with his T square, the use of which has been already described, make the line A perpendicular, so as to be at right angles with the horizontal line on each side, both above and below it: he must then, placing his rule upon the top of the line A, marked 1, in the direction he has sketched the line C, rule a line till it meet the horizontal line at G, which will be the vanishing point for all the horizontal lines on the left side of the house. From the same point 1, the top of the line A, following the direction of the sketched line D, another line must be drawn till it meet the horizontal line at the point H, which will be the vanishing point for all horizontal lines on the right side of the house. The rule must now be placed at the point 2, the bottom of the line A, and from it to the vanishing points, G and H, the lines J and K must be drawn, which lines represent the perspective inclination of the bottom lines of the house, as the lines C and D represent the perspective inclinations of the top lines. The lines E and F, determining the width of the two sides of the house, must now be corrected by the T square, taking care to draw the line E so as exactly to meet the lines C and J at the points 3 and 4, and the line F so as exactly to touch the lines D and K at the points 5 and 6. Here let the student well notice these three lines, A, E, and F, which, though really of the same height in nature, are all dissimilar in the perspective drawing. The line A, from being the nearest to him, appears the longest; the line E, from the left side of the house being

be on a level with the top of the house. Practice, and attentive examination of the works of clever artists, will gradually teach the amateur a good choice of position, upon which the agreeableness of his drawing greatly depends.

narrower than the right, is nearer to the spectator than the line F, and is consequently, though considerably shorter than the line A, much longer than F, the farthest removed from the eye.

The upper part of the left side of the house is terminated by a pointed roof, or what is called a gable, and the point of this gable in nature is perpendicularly over a point midway between the lines A and B. The student must be aware that the *perspective* centre of the side of the building cannot be exactly half-way between the lines A and B in the drawing, because that half of the building nearest to him must appear wider than the half that is farther off. If the centre is required of any rectangular parallelogram, it is found by ruling two lines from its opposite angles, which are called diagonal lines (Fig. 18), the intersection of which denotes the centre of the figure. So in perspective,—the space contained by the lines A, C, B, J, is a rectangular parallelogram in perspective; and if from the opposite points, where these lines join, as from 4 to 1 and from 3 to 2, the diagonal lines L and M are drawn, the point where they intersect at 7 is its perspective centre,* and the point of the gable must be drawn directly over it; to do which the student must draw a perpendicular line N through this point 7 above the line C; and at some point on this line the lines forming the sides of the gable must meet. In order to determine the height of the point of the gable, the student must continue the line A above the point 1. This line being the nearest perpendicular line, is the most convenient for finding the height of all objects on either side of the house. Let us suppose the height of the point of the gable to be five feet above the line C; this five feet must be set upon the line A, above the point 1. The student must therefore put on this line one-fourth of its length, as at 8, and from it (the

Fig. 18.



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* This mode of finding the perspective centre of a parallelogram by diagonal lines is eminently useful in sketching from nature; it often obviates the necessity for a great many points and lines that would otherwise be needed. The student will do well to bear it in mind.

point 8) rule a line O to the vanishing point G, where this line intersects the line N is the perspective position of the point of the gable, to which, from the points 1 and 3, draw the lines P and Q, which complete the drawing of the left side of the building.

The student is here shown the method of finding the exact perspective height of the point of the gable; but in sketching from nature it is quite sufficient to choose the point on the line N by the eye, and from it rule the lines P and Q,—as whether it is a trifle higher or lower is of little importance.

The mode used for finding the position and width of the windows, is similar to that for drawing the panels and framework of the door, in Fig. 2, Plate I. From the point 1 a horizontal line R must be drawn, to represent the geometrical length of the line D in the perspective drawing;* and on this line must be measured off at each end the distance of each window from the side of the house, as at 10 and 13, and from each of these points the width of each window, as at 11 and 12. From 9, the extremity of this line R, a line must be drawn through the point 5, till it meet the horizonial line at S; which point forms the point of distance, by which the width of all objects on the right side of the house is determined. From each of the points on the line R, viz. 10, 11, 12, 13, a line must be drawn to the point of distance, S; and where these lines intersect the line D (which represents R in perspective) they designate the perspective positions of these points, from each of which a perpendicular line, as 14, 15, 16, 17, must be drawn, till it touch the bottom line, K, of the building. The space between A and 14 represents the per-

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[*] It is immaterial to what length the line R is drawn, so that it be longer than the line D. The student must be aware that R, being the geometrical line represented in perspective by the line D, must necessarily be the longest. If the line R were lengthened so as to bring the point 9 further to the right, but keeping the distances and width of the windows in their relative proportions, the point of distance would be further to the left, but the intersections on the line D would be the same.

spective distance between the side of the house and the first window; that between 14 and 15, the perspective width of the first window; from 15 to 16 is the perspective width of the space between the two windows; from 16 to 17 the perspective width of the second window; and from 17 to the line F the perspective width of the space between the last window and the farther side of the house. It now only remains to determine the height of the windows, and their respective distances from the top and bottom lines of the building. Let us suppose that the upper window is one foot below the line D, and that the window is four feet high; a twentieth part (one foot) must be marked off on the line A below 1, as at 18, which will be the geometrical distance of the top of the window from the roof, and below this one-fifth of the line A (four feet), as at 19, which will be the geometrical height of the windows, and from each of these points a line must be drawn to the vanishing point H. Where the line drawn from 18 passes between the lines 14 and 15, and 16 and 17, it gives the perspective drawing of the top of each of the upper windows; and where the line drawn from 19 passes between the same lines, 14, 15, and 16, 17, it gives the perspective drawing of the bottom lines of the upper windows. Supposing the lower windows to be of the same height as the upper ones, and that they are three feet from the ground, these distances must be placed on the line A; that is to say, from the bottom, 2, of the line A, must be set up three-twentieths of its length (three feet), as at 20, and above that one-fifth of the length of A (four feet), as at 21. From each of these points, 20, 21, a line must be drawn to the vanishing point H; and where these lines pass between the lines 14, 15, and 16, 17, they give the perspective drawing of the top and bottom lines of the lower windows.*

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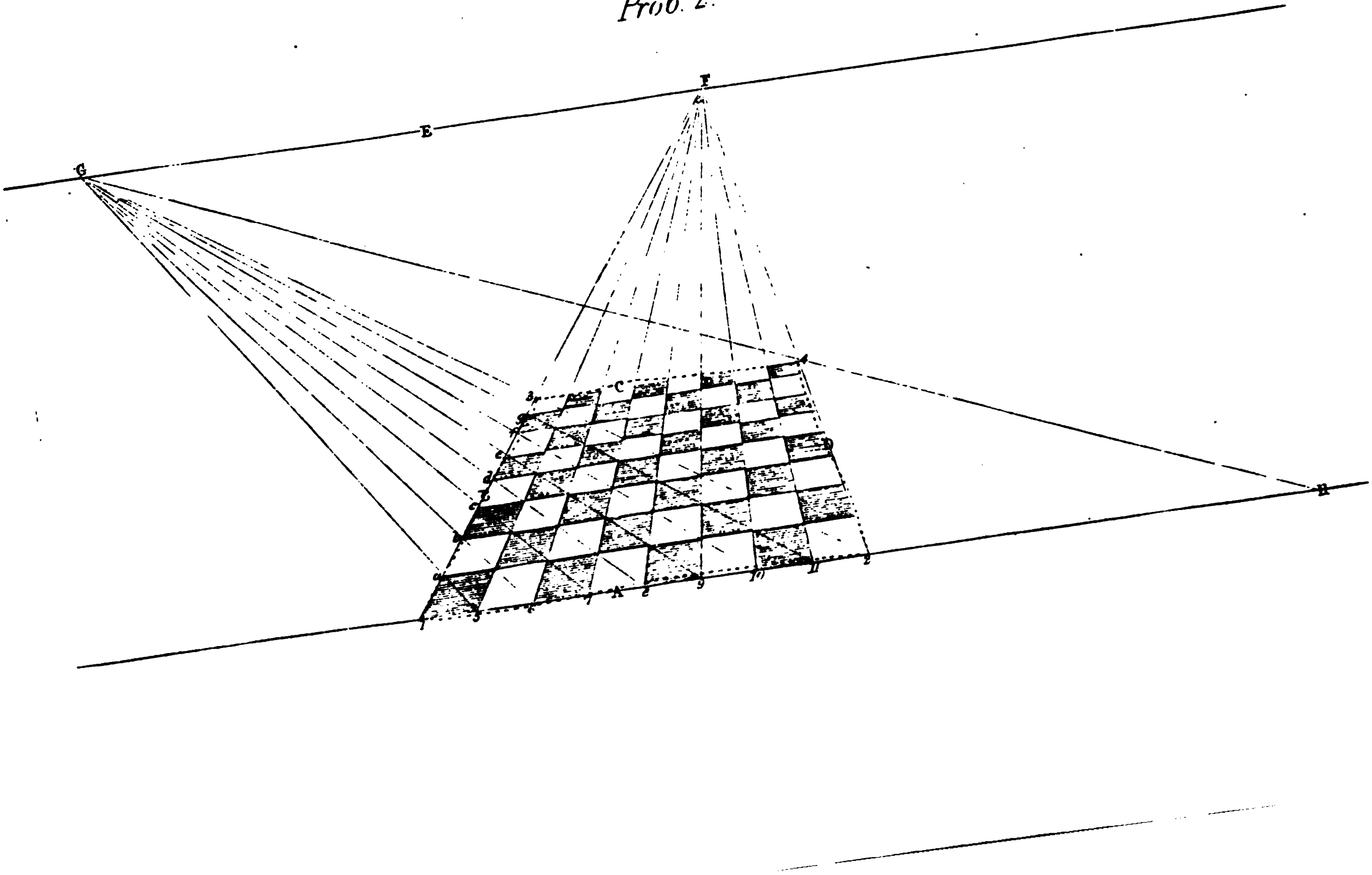
* The student should now draw in with a pen the strong lines, leaving the remaining lines, as well as the letters and figures, in pencil, and carefully preserve his drawings, as he will find them always useful, and towards the end of the work they may save him much time and trouble.

Prob. 2.



It is hardly necessary to tell the student, that the dark lines in the plates represent only the object to be drawn, and that the faint lines are those used for finding the correct perspective. In the foregoing example, on the right side of the drawing, the student is made to comprehend a mode for finding the perspective distance and size of any object on the face of a building: the forms chosen—the windows—are rectangular figures, as being the most simple; but the position and size of any object, whatever may be its form, can be ascertained by the same rule. In our progress we shall endeavour to render intelligible the mode of putting a variety of forms into perspective; but, like everything else, it is necessary to proceed step by step, and to thoroughly understand one problem before proceeding to another.

On the left side of the building the student is made to comprehend a mode for putting a pointed roof or gable in perspective; and, simple as it is, it is surprising the number of errors constantly committed by the neglect of its use. The author has seen many paintings where the artist, from mere carelessness, has brought the point of the gable nearer to the line represented by A than to the side represented by B, which is most offensive to the eye. Many of the Dutch and Flemish paintings show a great deficiency in perspective drawing; and the great Teniers, notwithstanding his beautiful representations of still-life, sadly outrages perspective in some of his out-of-door scenes.*

PROBLEM II.—In the foregoing example, the mode for finding a point of distance is given upon a line above the horizontal line: but many instances occur in drawing perspective where all the lines are below the horizon; as, for instance, a chess-board placed on a table, where, even in a sitting position, every line must be below the eye, or the squares on it could not be seen. The student should place a chess-board before him, so as to view it in the same position as that represented in the plate. He must first sketch, to the best of his judgment, the square of the board A, B, C, D.* The line A must be drawn over with a rule, to make it perfectly straight; and parallel to it, at the distance the eye is above the board, a long line, E, must be drawn across the picture to represent the horizontal line. From the point 1—the nearest left-hand corner—in the direction of the sketched line B, draw a line till it touch the horizontal line E at F, which will be the vanishing point. From the point 2—the nearest right-hand corner of the board—a line must also be drawn to the vanishing point F. These two lines, B and D, represent the perspective inclinations towards the vanishing point of the two sides of the chess-board; and the student will perceive how easily the two sketched lines are corrected. At the distance of from A to C, and parallel to A, a line must be drawn between B and D, to touch them at the points 3 and 4. The lines A, B, C, D, represent the outer lines of the chess-board in perspective. In order to regulate the perspective widths of the squares, which gradually diminish from the line A to C, it is necessary to find a point of distance. The chess-board being a square, the student will understand that the line B, between 1 and 3, is the perspective length of the line A, between 1 and 2. If the student then rule a line from the point 2, making it pass through the point 3, and continue it up to the horizontal line, the point G, where it touches, will be the point of distance, and will regulate the perspective lengths of the squares on the line B.† The line

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* There is an entertaining print by Hogarth, the title of which I do not recollect, that would amuse, and at the same time be useful to the young reader: in it he has outraged perspective as much as possible. The student would do well to examine it and find out its errors.

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* The dotted lines represent a sketch of the square of the chess-board, as it might be made by a beginner, to show with what facility a very indifferent sketch may be corrected by rule.

† It is immaterial whether the line B or the line D, each of which represents the perspective length of A, be taken for finding the perspective distances of the squares. If the student measure off to the right of the point 2 a space equal to the line A, between 1 and 2, and from its

A must now be divided into eight parts; and from each of the points of division, viz. 5, 6, 7, 8, 9, 10, 11, a line must be drawn to the vanishing point F. These lines represent the gradually decreasing width of the squares from A to C. From each of these points—5, 6, 7, 8, 9, 10, 11—a line must be drawn to the point of distance, G; and where these lines intersect the line B, at the points *a*, *b*, *c*, *d*, *e*, *f*, *g*, they represent the gradual decreasing length of each square from A to C. From each of these points of intersection, *a*, *b*, *c*, &c. a line parallel to the line A must be drawn till it meet the line D; and these lines, by their intersections with those drawn from the points 1, 2, 3, &c., give the perspective representation of the whole 64 squares of the chess-board. The alternate squares are slightly shaded, to make the figure perfectly intelligible to the juvenile student.

Here let it be understood, that when the four sides of the square, A, B, C, D, are put in perspective, if, in order to find a point of distance, a line had been ruled from the point 1 through the point 4, the point at which that line would touch the horizontal line would give a point of distance that would have produced the same result; observing, that in this case the points of intersection, *a*, *b*, *c*, *d*, &c., would have come on the line D instead of the line B.

PROBLEM III. — The student, in drawing this figure, must, according to the explanations given in Problem I., draw the nearest house, so far as it is described, up to the lines lettered to Q and figured to 8; observing that, with a view of exercising his ingenuity, the gable end is on the opposite side,—the letters and figures up to Q and 8 referring to similar lines in Problem I.

In* order to determine the perspective width of the second

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extremity, H, rule a line to the point of distance, it will intersect the line C at 4, the point determining the length of the line D by means of the horizontal line drawn from the point 3 of the line B.

[*] It must be understood that the description here commenced, and continued to the end of this and the following paragraph, is not the

and third houses, the same means might be used as employed for determining the position and width of the windows in Problem I.; that is, a horizontal line might be drawn to the right of the point 1, the top of the line A, and from any part of the horizontal line to the left of the line E a point might be chosen as a point of distance; and from it a line drawn through the point 3 till it meet this horizontal line, would give the geometrical width of the house between its point of contact and the point 1. If two similar spaces were measured off on this line to the right, to represent the geometrical width of the second and third houses, and from each of the points of division a line were drawn to the point of distance, where these lines intersect the line C would be the perspective widths of the second and third cottages. If the reader has thoroughly understood the First Problem, he would now have no difficulty in putting the gables to these two further houses, on the same principles as those used for drawing the first: but the author, in a long experience of teaching, has found so frequently that in the slightest variation in the application of a rule the juvenile student is apt to get bewildered, that, at the risk of being thought tedious, he will repeat the mode necessary for proceeding.

From each of the points of intersection on the line C, that determine the perspective widths of the second and third cottages, a perpendicular line should be drawn down to meet the line J; and these two lines, with the portions of the lines C and J lying between them, would represent the rectangular parallelograms of the second and third cottages, answering to that contained by the lines A, C, E, J, of the first. In each of these perspective parallelograms two diagonal lines should

description of the mode by which the gables in this representation are drawn. It is given in order to impress on the mind of the reader what he has already done, and to accustom him to comprehend perspective drawing by general description. The student would do well, however, to draw the problem on a separate sheet, according to the description here given.

be drawn, corresponding with the lines L and M in the first; and from their points of intersection two perpendicular lines should be drawn to touch the line O, similar to the line N drawn from the point 7 to 9. The line O ruled from the point 8 to the vanishing point G fixes the height of the first gable; and as it is supposed that all three of the gables are of the same height, the line O would also determine the height of the gables of the second and third cottages: so that where the line O would meet the perpendicular lines just drawn, would be the points where the two sides of the gable must meet. From each of these points to the top of the perpendicular lines right and left (corresponding to the points 1 and 3 of the first gable) draw the sides of the gables, corresponding to the lines P and Q of the first; and in a similar manner any number of cottages with gables may be continued on.

Where many gables follow in succession, as in a long row of houses with gable ends, or with garret or other windows having pointed tops, there is a rule for putting them in perspective much more simple than the foregoing, the use of which, with a little extra attention, the student will fully comprehend. Let us suppose that on some part of the front of each of these cottages was fixed a clock-dial, and let us further suppose the time marked upon each dial to be a quarter to twelve: the hour-hand of the dial would then be perpendicular, (or so nearly so, that, for the sake of our lesson, we must grant it to be perpendicular,) and the minute-hand in a horizontal position. To represent a series of dials with the hands in this position would not require any additional points, because the hour-hands, being perpendicular, would be parallel to the other perpendicular lines on the face of the building; and the minute-hands, being horizontal, would be drawn to the same vanishing point as the other horizontal lines on the face of the building: but if, instead of the hands of the dials indicating the time a quarter to twelve, they stood at ten minutes to five, they would then be at an angle both with the horizontal and perpendicular lines of the building. It has been already remarked, that all lines that are *geometrically parallel* are drawn in perspective to the same vanishing point. Now if the hands of all these dials stand precisely at ten minutes to five, all the minute-hands must be parallel to each other, and all the hour-hands must also be parallel, and certain points must be found by which the directions of the lines representing these hands may be drawn. The minute-hands of the dials pointing to the figure ten, the lines representing them must necessarily run upwards from the horizontal line, and some point must be found to represent them above it; but where, on the contrary, they point to the figure five, they would run downwards, and some point must be found to represent them below the horizontal line. These points are to be found on a line perpendicular to the horizontal line, either above or below it, and passing through the vanishing point.

As it would be with the hands of a series of dials just described, so is it with the lines corresponding with P and Q in a series of gables, these lines being at an angle both with the perpendicular and horizontal lines of the building and with each other. By finding the respective vanishing points for these two lines, the student will not only be enabled to find the perspective directions for an infinite number of gables, but in drawing them they determine the perspective width of each building.

To proceed with the drawing, which we left with the first house completed, as in Problem I. to the letter Q and figure 8. Through the vanishing point G a long line R must be drawn perpendicular to the horizontal line, above and below it; and the line P of the first gable must be continued upwards till it meet the line R at S, which will be the vanishing point for all the lines forming the left sides of the gables; all of which lines the student is aware are geometrically parallel. The line Q, the second line of the first gable, must then be continued downwards till it meet the line R at T, which will be the vanishing point for all the lines forming the right sides of the gables. From the point 3 a line must be drawn to the vanishing point S, which will give the perspective direction of the first line of the second gable: and where this line at 10 intersects the line O (which drawn from the point 8 regulates the height of each gable), it determines the point where the two lines of the second gable meet; and from it a line must be drawn to the vanishing point T, which gives the perspective direction of the second line of the second gable. Where this line intersects the line C, which gives the perspective height of all the lines from which the lines of the gables are drawn, it determines the perspective width of the second cottage, and from it the third gable is drawn precisely as was the second from the point 3. By the same process a fourth, fifth, or more gables may be drawn, at the will of the artist; the three given are quite sufficient to enable the student to comprehend the rule. But one of the most important features of this mode of representing the gables, is the facility and accuracy with which the perspective direction of the sloping line of the roof from the point 5 on F is drawn. It is a common error to draw this further line V parallel to the line P; but the student will readily perceive, from the example before him, as also by looking at nature, the inaccuracy of so doing—the further line V sloping much more than the line P. From the point 9, the point of the first gable, draw the line U to the vanishing point H; this gives the perspective direction of the upper line of the roof: then from the point 5 draw the line V to the vanishing point S; and where this line intersects the line U at 11 is a point corresponding to the point 9 on the line P. From each of the points of the second and third gables a line must be drawn to the vanishing point H, to give the direction of the upper lines of the roofs of the respective cottages, which completes the drawing. These additional points, S and T, are found to be valuable in various ways, as will be shown in our progress onward: they greatly facilitate the finding, the positions of chimneys or windows on sloping roofs of houses, of towers or spires on the sloping roofs of churches, &c.

The student will perceive that diagonal lines are put on the gable end of each cottage, and that perpendicular lines have been drawn from their points of intersection (the perspective centres of each gable end). This is done to demonstrate to the student that the mode of finding the points of the gables by means of the two vanishing points S and T produces the same result as that of finding them by means of the diagonal lines; the perpendicular lines drawn from the intersections of the diagonals passing directly through the points of the gables found by the vanishing points S and T.

Problem IV.—In a note in a former part of this work we drew the attention of the student to the advantage he would find from using the diagonal lines. In sketching from nature, it is rarely possible—neither is it necessary—to have the actual measurement of the objects to be represented; most of the relative proportions of one object with another must depend on the eye of the artist; but if the position and form of any one object be carefully drawn on one part of the face of a building, the position and form of any similar object in a corresponding part may be found by means of the diagonal lines. The skeleton of the house is drawn in the same manner as in the last problem and Prob. I. For the advantage of having the references distinct, the figure is drawn rather larger; in consequence of which the vanishing points are out of the picture, but they are referred to in the first and third problems as G and H; and the student in making his drawing must necessarily have them. The points to which the figures referred in the former problems, being unnecessary for our present purpose, are not marked; and the references by figures here given relate only to the new rule about to be explained.

The student must first, as before described (Prob. I.),

Prob. 4.

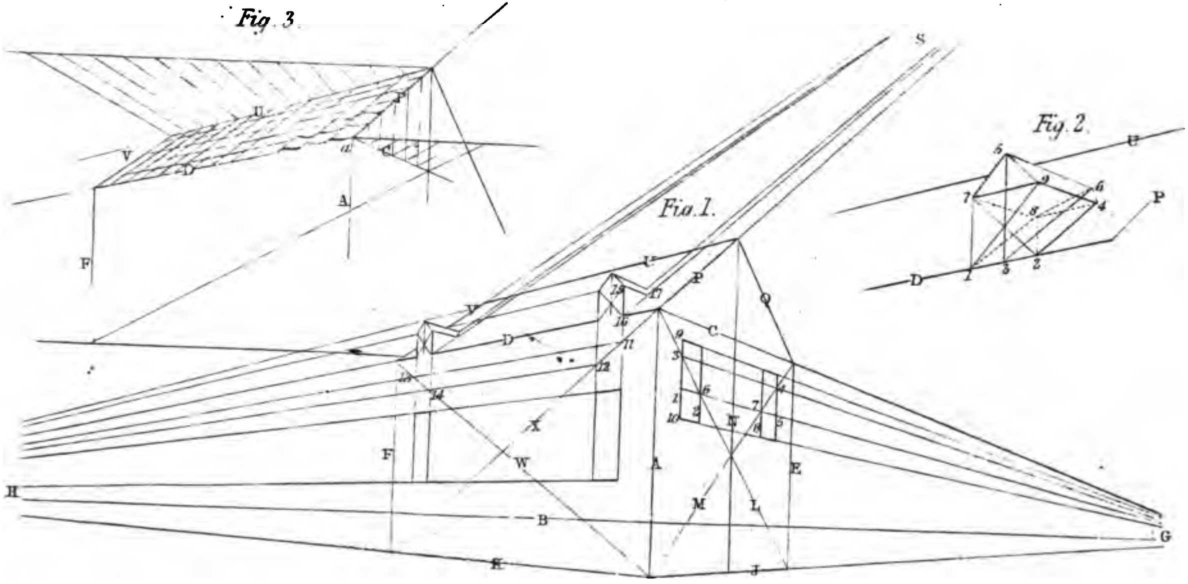


Fig. 3.

Fig. 1.

Fig. 2.

draw all the lines of the house, with their letters A B, &c. for reference, up to the letter Q, marking the respective vanishing points of each side, G and H. This done, he must sketch the position and size of the first window on the gable end of the house, and then with his T square draw correctly the lines 1 and 2, carrying them a little above and below the lines he has sketched for the top and bottom of the window. Now in order to get the relative distance of the second window from the line E that the first window is from the line A, it is necessary, from the point 3, where the line 1 intersects the diagonal line L, to draw a line to the vanishing point G. This line intersects the other diagonal line M at 4: and through this point of intersection 4 draw a perpendicular line 5. The point 4 on the diagonal M corresponds with the point 3 on the diagonal L, and the line 5 drawn through it is at the same relative distance from the line E that the line 1 of the first window is from the line A. To find the relative perspective width of the second window, from the point 6, where the line 2 of the first window intersects the diagonal L, another line must be drawn to the vanishing point G: and the point where it intersects the diagonal M at 7 corresponds with the point 6 on the diagonal L; through this point 7 another perpendicular line (8) must be drawn, which corresponds with the line 2 of the first window, and the space between the lines 5 and 8 represents, relatively to its perspective distance, the same as that between the lines 1 and 2. The ruler must now be placed on the line 1, at that point denoting the top line of the window, as a 9, and from it a line must be ruled to the vanishing point G: this will correct the original sketched line of the first window; and when it passes between the lines 8 and 5 it will represent the top line of the second window. The ruler must now be placed at the point on the line 1, that denotes the position of the bottom line of the window; and from that point a line drawn to the vanishing point G will give, where it passes between the lines 1 and 2, the bottom line of the first window and where it passes between the lines 8 and 5, the bottom line of the second.

In the first window, just drawn, the perpendicular lines forming the sides intersect the diagonal line L, as at 3 and 6; and consequently the corresponding points on the diagonal line M are found easily, by ruling at once from these points to the vanishing point G. But it happens sometimes that the windows are so situated on the face of a building, that their sides neither intersect nor touch the diagonal lines. In order to point out the mode of proceeding when the windows are so situated, we will take the other side of the building. We will suppose a window to be in the situation of that represented in the engraving near the line A, between that line and F: this being sketched, the diagonal lines W and X must be drawn. The student will here perceive that neither of the upright lines of this window touch the diagonal lines; the student must therefore with his T square, continue them upwards till they meet the diagonal line X at the points 11 and 12, and from each of these points draw a line to the vanishing point H. Where the upper line intersects the diagonal line W at 13, is a point corresponding with the point 11 on the diagonal line X; and where the lower line intersects the diagonal line W at 14, is the point corresponding with the point 12 on the diagonal line X. From each of these points (13 and 14) a perpendicular line must be drawn downwards; and the space between these two lines represents the perspective width of the second window, at its perspective distance from the line F, corresponding with the distance of the first window, from the line A. The upper and lower lines of the second window are found, as on the other side of the house, by continuing the lines of the top and bottom of the first window to the vanishing point H.

Let us now suppose that on the roof there are two garret windows, situated immediately over the two windows just drawn, of the same width, and each window having a pointed roof. To find their width and position, the upright lines of the windows just drawn must be continued up through the line D, which will form their sides. Let any point on the nearest of these upright lines be chosen, as at 15, to fix their height (the mode for getting a fixed height would be the same as that explained for getting the height of the gables, Problem I. 8, o), and from it rule a line to the vanishing point H; this, crossing the upright lines already drawn, will give the rectangular parallelograms of the garret windows in perspective: and as there are only two garret windows, and consequently only two pointed roofs, to be drawn, the readiest way will be to find the situation of the points by raising perpendicular lines from the intersection of the diagonal lines of each parallelogram. The pointed roofs of these two windows are here drawn, and the lines used for finding them left; but it would be quite superfluous again to go over the explanation of drawing them. In order to find the side of the first garret window, it is necessary first to draw a line from the point of the gable to the vanishing point G, as also from the point 15 to the same vanishing point, which lines will represent the perspective direction of the upper and lower lines of the roof of the garret window,—and which, the student must understand, in the real object are parallel to the horizontal lines on the gable side of the house. To find the points where these two lines terminate on the roof of the house, will require a little attention: the rule is similar to that employed for finding the directions of the gable in Problem III. The student must first find the vanishing point for the line P of the gable of the house. The lines of each of the sides of these windows, where they touch the roof, are in reality parallel to the line P of the gable (because the whole side of the roof is a uniform slope), and must consequently vanish to the same point; therefore, from the point 16, where the upright line of the window touches the lower line of the roof of the house, a line must be drawn to the vanishing point S; and where this line intersects that drawn from the point 15 to the vanishing point G at 17, is the point marking the spot where the lower line of the roof of the garret window touches the sloping roof of the house. To find the point where the upper line of the roof of the garret window touches the sloping roof of the house, is a little complicated; and to render it quite clear, an additional figure is introduced. Fig. 2 is drawn up to the point marked 17 of Fig. 1. The window here drawn contains the lines of both sides, as if it were transparent. The student will observe that the point of the front of the gable comes directly on a line, exactly midway (perspectively) between the two sides; consequently, the point at the back must come on a line midway between the sloping lines on the roof forming the two sides; from the points 3 and 1, two lines have been drawn towards the vanishing point S. Where the line drawn from the point 3 meets the line drawn from the point of the gable 5 to the vanishing point G at 6, is the point where the two sides of the roof join; and a line drawn from the point 6 to 4 will complete the drawing of the first garret window. The student will observe, that where the line drawn from the point 1 to the vanishing point S intersects the line drawn from the point 7 to the vanishing point G at 8, the lines forming the triangle 1, 7, 8, represent the farther side of the window, and correspond with the lines forming the triangle 2, 9, 4, the near side; the lines forming the triangle 4, 8, 6, represent the form of the gable on the sloping roof of the house, and correspond with the lines forming the triangle 7, 5, 9. The garret windows in the drawing (Fig. 1) must now be completed, in the manner described in Fig. 2; and the highest line of the roof of the house, U, with the extreme line of the slope, V, drawn to their respective points, as in the preceding problem (III.); and this figure will be finished.

The rules given in this and the preceding plate will be found useful for drawing the divisions of tiles or slates on the roof. In Fig. 3, that portion only of the drawing of the house is introduced necessary for the purpose. The lines A, C, D, F, P, U, V, are drawn as before described. From the point of the gable a horizontal line must be drawn to the left, to represent the geometrical length of the perspective line U; this geometrical line must be divided into as many equal parts as there are tiles in each row, and a point of distance found, to give the perspective positions of these several divisions on the line U. These being found, a line must be drawn through each from the vanishing point S to the line D, which will give the correct perspective direction of the divisions of the tiles or slates. From the point *a*, a horizontal line must be drawn to the right, to represent the geometrical length of the near half of the line C; and this geometrical line must be divided into as many equal parts as there are rows of tiles on the roof, and a point of distance found to get the perspective positions of these points on the near half of the line C. These divisions, however, are required on the line P, and from each point of intersection on C a perpendicular must be drawn till it touch the line P, and from each point of contact a line must be drawn to the vanishing point H, which, by their intersections with the lines drawn between U and D, give the relative forms and positions of the different tiles; as the lines crossing each other in Prob. II. represent the 64 squares of the chess-board. The tiles may be of various forms; but we do not attempt to do more at present than point out the mode of finding the perspective distances. The student may easily, on these, draw any form of tile that may happen to have been used, as in the example just given.

The rules employed in this problem will be found extremely useful; the positions of all the objects in Fig. 1 are found without the necessity for using a point of distance, the diagonal lines answering for that purpose: they produce equal correctness, and save time and labour. The rule for finding the triangle 8, 6, 4, in Fig. 2, will be found useful in drawing roofs of buildings, where the pointed ends slope back as well as the sides; a mode of construction very common in old buildings, especially abroad, and not unfrequently met with in the roofs of country churches.

Before proceeding to the following pages, the author strongly recommends the student to choose certain familiar articles composed of straight lines, and endeavour to put them in perspective, according to the rules already explained.

CHAPTER III.

It is now necessary to advance a step farther. We trust the directions for drawing the foregoing problems will be found sufficiently clear to enable the young student to draw the superficies of any object of simple form represented by straight lines: thicknesses, such as the width of objects, like windows, doors, &c., have been purposely omitted in the preceding problems. The rules for drawing these thicknesses are the same as those employed in drawing the superficial forms, but demand a considerable number of additional lines; these would tend seriously to embarrass the student, from their complication: it is therefore thought advisable to postpone this portion of our work, till the reader, by gradually accustoming himself to this mechanical drawing, will be less liable to become perplexed with a multiplicity of lines. We will therefore proceed with some rules necessary for drawing curves in perspective; and, as the most simple, we will commence with the circle.

Let us suppose that a series of semicircular arches were to be drawn in perspective. We trust that the reader has so far profited by the foregoing examples, that he would have no difficulty in finding the width of each arch, the width of each column, pilaster, or pier between the arches, and their gradations of height. All this can be accomplished by the use of a common ruler, because it can be done by means of straight lines: but no ruler has yet been invented that will enable the student to draw the changes of forms taken by curves in perspective. The mode of proceeding is, first to draw geometrically the curve intended to be represented in perspective, and through this geometrical figure to draw in certain directions various straight lines, that shall intersect or touch one another in certain points of the curve; to put these straight lines in perspective which will change the relative positions of the various points, and through them, by hand, to draw the curve in perspective. In this diagram (Fig. 19) for instance, we have a circle drawn; and in order to find certain points in this circle, that will enable us to put it in perspective, it is enclosed in a square; and the student will perceive that the circle touches at four points of this square, exactly at the points of contact of the two cross lines. Nothing can be more simple than to put the six straight lines of this diagram in perspective; which, when done, would furnish four points through which the curve line forming the circle in perspective must be drawn. But four points are not found sufficient for the representation of a circle in perspective; we must therefore find some additional points, by adding to the straight lines already drawn, two diagonal lines (Fig. 20). The student will here observe that these diagonal lines intersect the line of the circle at four other points, exactly midway between those in the former diagram. Let us now proceed to construct the figure.

Fig. 19.

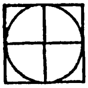
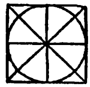


Fig. 20.



Problem V.—The student ought now, without assistance, to be able to put in perspective the square, the diagonal lines, and the perpendicular and horizontal lines that pass through the centre; but that no error may by possibility occur, we will give him a little aid. First, below the ground line, of any size that may be required, he must construct a geometrical figure similar to the second diagram given in the preceding paragraph, and taking the upper line of the square of this diagram for his first line, draw the square in perspective;* then from the opposite corners draw the two diagonal lines: from the point 1 draw a line to the vanishing point, and through the centre of the square (where the diagonal lines intersect) draw a horizonual line across, from the line D to the line E, to the points 4 and 2 The student will here perceive that he has put in perspective the straight *lines* contained in the second diagram above, and found the four *points* contained in the first: viz. the points marked 1, 2, 3, 4 of the geometrical drawing here given. It was observed, in the foregoing paragraph, that certain straight lines must be drawn, that shall intersect or touch one another at certain points of the curve, &c. Now the student will perceive that the diagonal lines drawn in the second diagram, though they intersect the line of the circle, have no points of intersection with any other straight lines, and that therefore these diagonal lines in the perspective drawing in this stage are quite useless: in order, therefore, to find the points where the diagonal lines intersect the circle, we must have two additional straight lines. In the square of the geometrical drawing on each side, through the points where the diagonals intersect the circle, draw a line running from the top to the bottom line of the square, as the line A passing through the points 6 and 7, and touching the bottom line of the perspective square at 9, and the line B passing through the points 5 and 8, and touching the bottom line of the perspective square at 10. From each of these points 9 and 10 a line must be drawn to the vanishing point; and where the line drawn from the point 9 intersects the first diagonal, it gives a point corresponding with the point 6 in the geometrical drawing; where it intersects the second diagonal line, it gives a point corresponding with the point 7. In like manner the line drawn to the vanishing point from the point 10, at its intersections with the diagonal lines, gives two points corresponding with the points 5 and 8 of the geometrical drawing.

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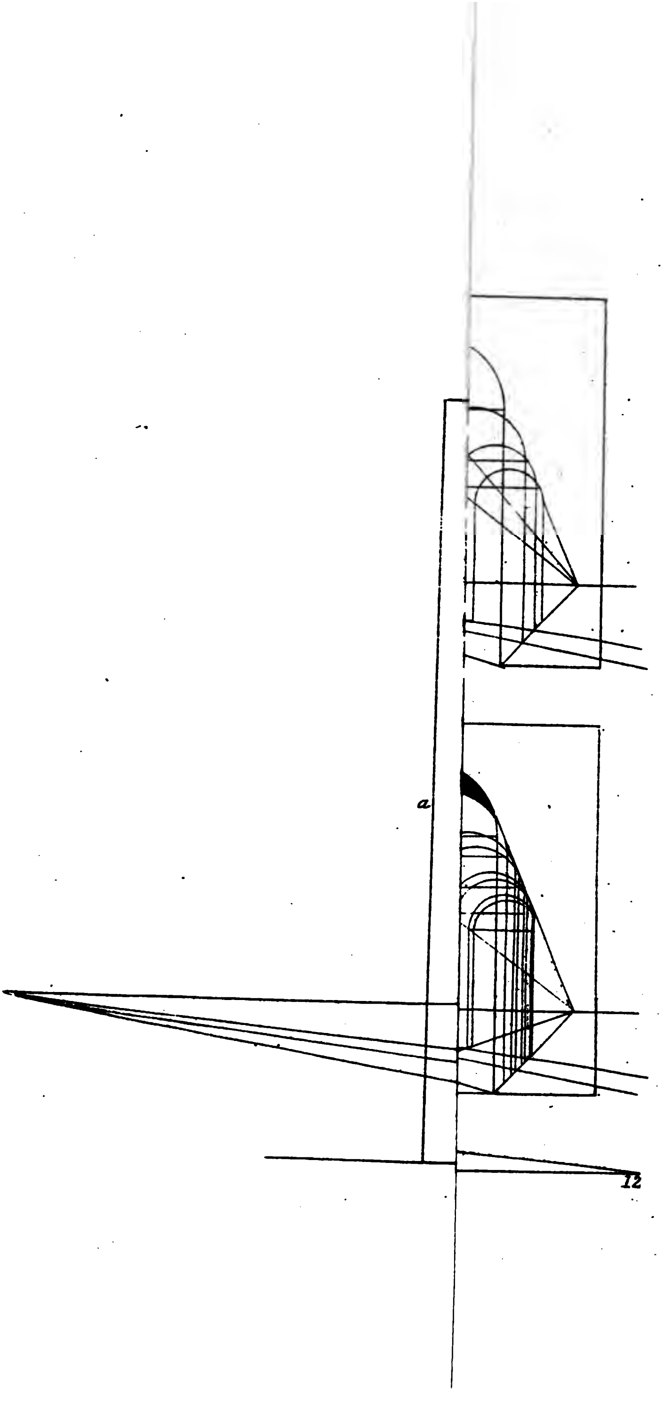
* By referring to the drawing of the chess-board, Problem II., the manner of drawing the square in perspective will be found.

The perspective positions of the whole of the eight points being thus found, the student must carefully draw the curve to represent the circle, touching the points 1, 2, 3, 4, and passing through the points 5, 6, 7, 8. This mode is generally found sufficient for all ordinary purposes; but where circles are required to be drawn in perspective of very large dimensions, more points of intersection may be found in the geometrical drawing: these do not at all increase the difficulty, on the contrary, the curve line is drawn with more ease and accuracy; but the multiplicity of lines would be apt to puzzle the student, and, as we before remarked, the foregoing is quite sufficient for all ordinary purposes.

Let us suppose that the circle just drawn represents the spot on which a column is to be erected, and that a row of these columns is to be built; that the columns are to be distant from each other exactly their own width, and that the circle is marked on each spot where a column is to be erected. In order to represent this in perspective, it is first necessary to find a point of distance: this must be done by the same rule employed in Problem II. (the finding the point G). The student must first find the proper distance for, and afterwards draw, the perspective square in which the circle is to be drawn. To find the distance, he must measure off on the ground line, and on the opposite side to where he has fixed his point of distance, two spaces of the width of the geometrical square; and from each point of division, 11 and 12, a line must be drawn to the point of distance C. Where the line drawn from the point 11 intersects the line D at 13, it gives the perspective distance between the two circles; and where the line drawn from the point 12 intersects the line D at 14, the space between that point and the point 13 represents the left side of the square in perspective in which the second circle is to be drawn. From the points 13 and 14 two horizontal lines must be drawn to touch the line E at the points 15 and 16. These two lines, with the portions of the lines D and E between their extremities, form the four sides of the square in perspective in which the second circle is to be drawn. From the points 13 to 16 and 14 to 15 draw two diagonal lines, and through their points of intersection draw a horizontal line between the lines D and E. The line running from the point 1 of the first square, in passing through the bottom and top lines of the second, gives the points corresponding to the points 1 and 3 in the first. The line running from the point 9 of the first square, where it intersects the diagonals of the second, gives the points corresponding with the points 6 and 7 of the first: in like manner, the line running from the point 10, at its intersections with the diagonal lines of the second square, gives the points corresponding with those marked 5 and 8 in the first; and the horizontal line passing through the centre of the second square, gives, at its points of contact with the lines D and E, points corresponding with the points 4 and 2 in the first. The whole of the eight points being thus found in the second square, it remains only, as before described, to draw the curve line through them, which will represent the perspective position and form where the base of the second column is to be placed. By continuing in this manner, a third, fourth, or any number of circles may be drawn at their perspective distances: the two given are quite sufficient to illustrate the rule.

It may here be well to remark, that every circle correctly drawn in perspective forms a perfect ellipse, whether, from the position from which it is viewed, it appear broad or narrow. By those who understand perspective but imperfectly, this is frequently denied: and their disbelief arises from their mistaking the middle horizontal line for the axis of the ellipse, whereas it simply divides the circle into its *perspective* halves. If all the lines serving to draw the curve were to be erased, and the curve left; if its proper axis (a long straight line, that divides it longitudinally into two equal parts,) were to be found, it would show that the curve forms a true ellipse.

PROBLEM VI.—By the application of the same rule as that explained in the foregoing problem, with a little variation in the manner of employing it, an arcade or succession of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13 and 14, and 16 and 17, are found as in Fig. 1; and the student must now find, by drawing a perpendicular line dividing the arch into its perspective halves,* the point corresponding with the point 19 of Fig. 1, and from it draw a line to each of the points 13 and 14. The line G, where it intersects the diagonal lines of the half-square in perspective, will give the points corresponding to the points *a b* in the plan at the side, through which to draw the curve, and in its possage towards the vanishing point would give the corresponding point for every arch. In the example here given, those lines only are used that are absolutely necessary for the explanation of the rule; the student will do well to draw the whole figure with the five arches on this plan.

Problem VII.—The reader has, doubtless, at one period or another, been in some place where he has seen a row of arches straight before him, such as the Burlington Arcade, the side aisle of a church, &c. Let him suppose, then, that he is standing before a row of arches, and in such a position as that the point of sight (in this case, also the vanishing point,) be exactly in the middle, between the two sides of the arch.

Fig. 1. The student must first draw the elevation of the first archway: this is so extremely simple, that it scarcely needs any directions. Having drawn the external lines, *a*, *b*, *c*, the ground line, and the horizontal line, draw the sides of the archway A and B, up to the points 1 and 3 (from where the curve springs), and draw a horizontal line between these two points: from the centre of this line, at the point 5, with a pair of compasses describe a semicircle from the points

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* The student, it is to be hoped, recollects that the centre of any rectangular parallelogram in perspective is found by the intersection of its diagonal lines. The figures 6, 7, 13, 14, represent the four corners of a rectangular parallelogram in perspective, as do also the figures 13, 14, 16, 17, and 6, 7, 16, 17. If the student, in any one of these, draw two diagonal lines, as from 7 to 13, and from 6 to 14, and through this point of intersection draw a perpendicular line to F, it will give the point (19) required.

1 and 3. From each of the points 1, 2, 3, 4, draw a line to the vanishing point.* The student must now on the line C (drawn from the point 1 to the vanishing point), mark the distance of the second arch from the first, as at 6, and from this point draw a perpendicular line till it touch the line D, at 7. From the line A, through the point 7, draw a horizontal line, till it touch the line B; and from the point 8, where it intersects the line F, draw a perpendicular line to meet the line E at 9. The points 6, 7, 8, 9, are the points of the second archway, corresponding with the points 1, 2, 3, 4 of the first. Draw a horizontal line between the points 6 and 9; and from the point 5 draw a line to the vanishing point: where this line intersects the line 6 to 9 just drawn, at 10, with a pair of compasses open to the distance of from 10 to 6, or 10 to 9, which are equal, describe another half-circle; this completes the second archway.

We will suppose the archways to be equidistant from each other, and that the distance between each is a space equal to from A to B. In order to find the relative distance the third arch appears from the second that the second appears from the first, we must find the point of distance, which may be found in a similar manner to that employed in the Problems II. and V. From the point 4, passing through the point 7, a line must be drawn till it meet the horizontal line; the point of contact is the point of distance. To the right hand, from the point 4, two spaces must be measured off on the ground line, each equal to the space between A and B, as at 11 and 12; from each of these points a line must be ruled to the point of distance, and where they intersect the line D they give the points determining the perspective distances of the third from the second arch at 13, and the fourth from the third at 14. The mode of drawing the third archway is similar to that employed for the second, with this difference only, that the perpendicular line must be drawn up from the

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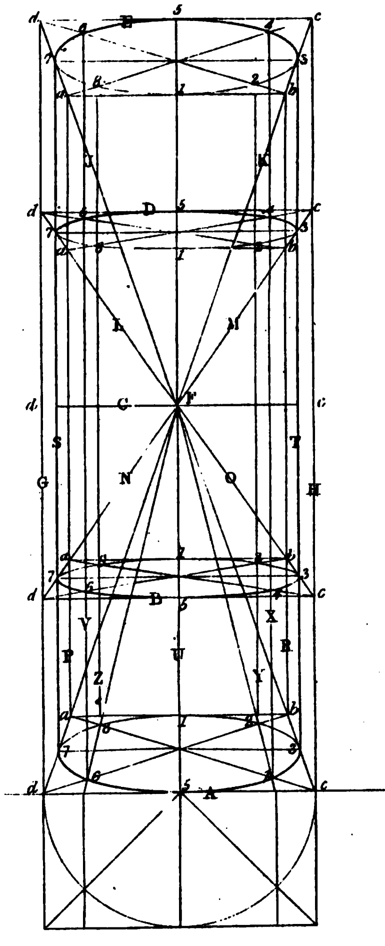
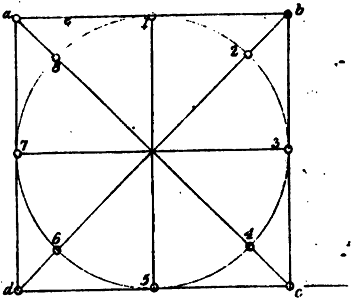
* This point has already been settled to be placed midway between the two sides of the arch.

Prob. 8.



Diagram



point 13 on D to the line C; whereas the second arch was commenced by drawing a perpendicular line down from the point 6 on C to the line D. To draw the third archway, raise a perpendicular line from the point 13 till it meet the line C at 15; from 15 draw a horizontal line till it meet the line E at 16; from 16 draw down a perpendicular line to meet the line F at 17; draw a horizontal line between 15 and 16, and from the point midway between them describe a third semicircle; this completes the third archway. The fourth is drawn in a similar manner, commencing at the point 14; and a fifth, sixth, or indefinite number, may be continued by the same rule.

If, however, instead of being placed exactly in the middle, between the two sides A B of the archway, the spectator had placed himself a little on one side—as opposite the point marked G on the horizontal line, the arches would have had a very different appearance. Viewed from this position, more of the left side of the inner archways would be visible, and the right side of the first archway would entirely exclude the view of the right side of the inner ones. The appearance of the archways, as seen from this position, would be as represented in Fig. 2.

In this example there are neither letters nor figures of reference: the mode of drawing it is exactly similar to that employed in Fig. 1, the position of the vanishing point only being altered. The student will observe that the right side of all the inner arches is hidden by the first, and that a portion only of their semicircles is seen; nevertheless, it is best to complete each archway in the drawing, to insure correctness; and this would be more necessary if it were drawn in oblique instead of parallel perspective. A few of the lines are left, to assist the student in his drawing the figure. Fig. 3 we shall have to consider in a more advanced part of the work.

PROBLEM VIII.—In the introductory portion of this work, it will be recollected that some observations were made respecting circular objects; and the various forms they took, according to the positions from which they were seen, was familiarly explained by the example of a common bowl. It has already been remarked, that all perspective representations of circles form perfect ellipses;* but the width of these ellipses varies according to the distance the circular form is placed above or below the eye of the spectator. To illustrate this, a column, composed of five distinct pieces, is chosen, and the spectator is supposed to view it from such a position as to bring the vanishing point (F) exactly in the centre of the column, and midway between the top and bottom. The student will understand that the joints of a circular column are circular, like the top and bottom, and that the forms of the curves of the joints vary in appearance according to their distance above or below the eye of the spectator. The student will observe that the curve or ellipse A, the base of the column, from being at the greatest distance below the eye, is much broader than the curve B, representing the first joint; that the second joint of the column C, from its being exactly level with the eye, forms only a straight line; for if the student imagine, that instead of this joint he had before him a thin circular plate, from its being exactly level with his eye, it would be impossible to see either its upper or lower surface, and consequently could only be represented by a straight line. The curve D, from being the same height above the eye that the curve B is below it, forms a precisely similar ellipse; and, for the same reason, the ellipses A and E are also similar: this the student will readily perceive by turning the example upside down. The curves D and E, from being above the eye, show the upper half of the curve; the curves B and A, from being below the eye, show the lower half.

In order that the student may fully comprehend the draw ing of this problem, let him cut five square pieces of card, and draw on the face of each of them a figure similar to the diagram represented in the plate; and through each card, at the points *a*, *b*, *c*, *d*, and 1, 2, 3, 4, 5, 6, 7, 8, pierce a hole, as also through the point at the centre. This done, let him place the cards one over another, so that the various points of each card shall lie under and over the corresponding points of the others. In this position of the cards, let him put a piece of stick or wire, the length of the column, through the centre holes, and separate the cards on this stick to an equal distance one from another, always keeping the corresponding points on the cards in the same relative position. If the student were now to put a straight piece of wire (a common knitting-needle will answer the purpose) through any one of the points of the top cards, and holding it perpendicular, were to push it downwards, it would pass through the corresponding holes in the four cards underneath. By clearly understanding this, the student will find his progress through the problem greatly facilitated.

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* The only exception is where the curve comes, as in the joint C of this figure, exactly on a level with the eye of the spectator. in which case it is represented by a straight line.

The student must first draw the square, and find the points in perspective, corresponding to the points in the diagram, for drawing the curve of the base of the column. This is fully explained in Problem V., with this slight variation, that the vanishing point in this drawing is placed in the middle of the object to be represented, instead of at the side: this done, he must letter and figure the several points to correspond with the letters and figures on the points in the diagram, as the points *a*, *b*, *c*, *d*, 1, 2, 3, 4, 5, 6, 7, 8.

From the points *d* and *c* draw two perpendicular lines, G and H, each four times the height of the side of the square of the diagram, marking on each line the divisions of each fourth, as at the several points marked *c* and *d*,* and draw a horizontal line between the lines G and H, from each point, *c* to *d*, up to the top. The first three of these horizontal lines, B, C, and D, represent the first line of the three squares in which the curves to represent the joints are to be drawn. the fourth line, E, represents the first line of the square in which the curve to represent the top of the column is to be drawn. From each of the points *c d*, the extremities of the lines B, D, E, a line must be drawn to the vanishing point F, as the lines J, K, L, M, N, O.*

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* The student must understand that the same figures and *small* letters are employed as references for the corresponding points in each of the squares, and that the several squares, with their first line and the

By reference to the cards, in the position before described, the student will perceive that the circles drawn on them are in a similar position to that of the top and bottom, and the three joints of the column; and that a perpendicular line passing through any one of the points, representing certain points in the circle on the top card, would pass through the corresponding points in the cards beneath. So is it in the perspective drawing; the corresponding points in the several perspective squares lie exactly one over the other, and will be found by means of perpendicular lines.

From the point *a* of the first square A, a perpendicular line P must be drawn till it meet the line J of the square E at *a*; and from the point *b* of the square A, a perpendicular line R must be drawn till it meet the line K of the square E at *b*; by drawing a horizontal line between these two points *a* and *b* (square E), the square E will be completed. The student must here understand that the several lines J, L, and N, drawn from the points *d* to the vanishing point, represent the perspective directions in each of the squares B, D, and E, of the line *d—a* of the diagram; and that the line P is the perspective representation of the wire passing through

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curve drawn within them, are alike designated by their respective letters, A, B, C, D, E.

* The middle joint C being represented by a straight line, no points can be required on it. It will only be necessary to determine its perspective width, which will be done in determining the width of the other curves.

the points *a* of the cards: consequently, where the line P intersects the lines N, L, and J, it gives the perspective positions of the points *a* in the several squares B, D, and E. In like manner the lines K, M, O, running from the point *c* to the vanishing point, represent the perspective directions in each of the squares of the line *c—b* of the diagram; and the line R is the perspective representation of the wire passing through the several points *b* of the cards: consequently, the points at which this line intersects the lines K, M, and O, are the perspective positions of the several points *b* in the respective squares B, D, and E. The student must now draw a horizontal line from the points *a* to *b*, in each of the squares B and D; and then, in each of the three squares B, D, E, he must draw the diagonal lines from the points *d* to *b*, and from *a* to *c*.

From the point 7 (square A), the point designating the extremity of the perspective circle to the left, a perpendicular line S must be drawn till it meet the line J (square E); and from the point 3, the extremity of the perspective circle on the right, a perpendicular line T must be drawn to meet the line K (square B). These lines S and T, represent the two sides of the column, and are the perspective delineation of the wires passing through the holes 7 and 3 of the cards: consequently, where the line S intersects the lines representing in perspective the line *d—a* of the diagram (those portions of the lines J, L, and N, between the letters *d* and *a*), it gives the perspective positions of the points 7 in the respective squares B, D, and E. In like manner, where the line T intersects those portions of the lines K, M, O, between the letters *c* and *b* (representing the line of the diagram *c—b* in perspective), it gives the perspective positions of the point 3 in the respective squares B, D, and E.

The student must now, from the point 5 of the square A, draw a perpendicular line U, till it touch the top line of the square E; and this line, from the spectator being placed exactly in the centre of the column, will answer for a perpendicular line that should be drawn from the point 1, square A, till it touch the further line of the square E. This line U, then, represents in perspective the wires passing through the holes 5 and 1 of the cards, and designates at its intersections on the first line of each square the point corresponding with the point 5 of the diagram; and at its intersections with the further line of each square it designates the positions of the points corresponding with the points 1 of the diagram. The student will perceive that he has now, in each of the perspective squares, points for drawing the curves corresponding with the points 1, 3, 5, 7 of the diagram; he must now find the remaining points, 2, 4, 6, 8, in each of the squares.

From the point 6 on the diagonal line *d—b*, square A, a perpendicular line V must be drawn, till it touch the diagonal line *d—b*, square E. This line V represents in perspective the wire passing through the holes 6 of the five cards; and where it intersects the several diagonal lines *d—b*, in the respective squares B, D, E, will be a point corresponding to the point 6 in the diagram. In like manner, from the point 4 on the diagonal line *c—a*, square A, a perpendicular line X must be raised, till it meet the diagonal line *c—a*, square E. This line X representing the wire passing through the points 4 of the cards, will give, at its intersections on each of the diagonal lines *c—a*, a point corresponding with the point 4 on the diagram. Similar to the preceding perpendicular lines V and X, the two others, Y and Z, must be drawn from the points 8 and 2 on the diagonal lines *c—a* and *d—b*, square A, to meet the corresponding diagonal lines *c—a* and *d—b*, square E; these will give the perspective representations of the wires passing through the holes 8 and 2 of the five cards. Where the line Y intersects the diagonal lines *d—b* of the several squares, will be found the points corresponding with the point 2 of the diagram; and where the line Z intersects the diagonal lines *c—a* of the several squares, will be the points corresponding with the point 8 of the

Prob. 9.

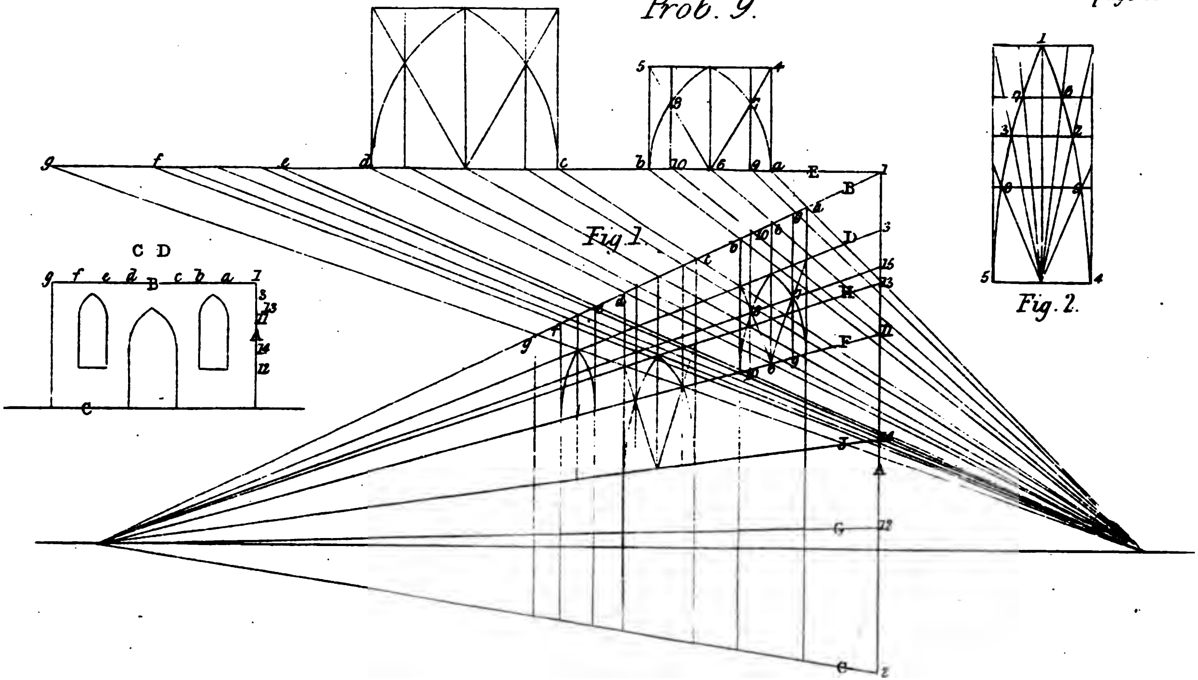


Fig. 1.

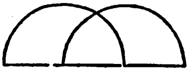
Fig. 2.

diagram. The whole of the perspective positions of the points of the diagram being found in each perspective square, the student, as in Prob. V., must draw the curve in each, through the several points 1, 2, 3, 4, 5, 6, 7, 8, which will complete the perspective drawing.

This problem, though not difficult, requires attention, from its being a little more intricate than any preceding; but, with the assistance of the cards, the author thinks it barely possible for the intelligent student to fail understanding it.

Problem IX.—In sketching from nature, the artist has frequently to represent, and in old buildings especially, doors, windows, arches, &c. of a pointed form, commonly called gothic arches, gothic windows, &c. The curves of these pointed arches are formed in geometrical drawing by the intersections of segments of circles, Fig. 21. The pointed arch here drawn is formed by the intersection of two semicircles; and by the rules already explained, the student would be able easily to put it in perspective; as by putting the two semicircles in perspective, their intersection would give the pointed arch, which would be in perspective also. But these pointed arches vary so much in their proportions, some being extremely obtuse, whilst others are very pointed, that it is better to give a general rule by which pointed arches of any form may be put in perspective. At the side of the problem, an elevation of the building to be put in perspective is drawn, representing a gothic arched doorway, with a gothic window on each side; and, like the elevation in Problem VI., it is drawn to the scale of one-fourth of the perspective drawing: the student will therefore bear in mind, that in making for his perspective drawing geometrical measurements, they are understood to mean four times the size of that given, and marked G D.

Fig. 21.



The whole of this figure, with the exception of the curves of the doorway and windows, must be drawn in a similar manner to Prob. VI. The line A must first be drawn; and across the picture, at the height of the spectator's eye, the horizontal line; then the line B, the perspective top line of the building, to the horizontal line, to fix the vanishing point; and from the bottom of the line A, a line C to the vanishing point, for the perspective base-line of the building. The point 3 on A, the geometrical height of the pointed top of the windows, must next be marked, and from it the line D drawn to the vanishing point, to regulate their perspective height. The line E must next be drawn, and on it the geometrical widths of the doorway, windows, and spaces between must be marked, as at *a*, *b*, *c*, *d*, *e*, *f*, *g*; a distance-point must next be found, to get the perspective positions of these points on the line B.* The distance-point having been found, and the perspective positions of the points *a*, *b*, *c*, *d*, *e*, *f*, *g* marked on the line B, draw from each of these points a perpendicular line till it touch the line C.

On the line E, between the points *a* and *b*, construct a geometrical figure of the arch of the first window. This is done by fixing one point of the compasses at the point *a*, and opening them till the other point touches the point *b*; describe upward the segment of a circle, and then changing sides, and fixing the point of the compasses (at the same extension), at the point *b*, describe another segment of a circle from the point *a*, till it join the one before drawn: this will give the geometrical drawing of the arch. From the points *a* and *b* draw up two perpendicular lines, and, just touching the point of intersection of the arch, draw a horizontal line to meet them at the points 4 and 5. From the point of the arch draw down a perpendicular line to touch the line E at 6, and from the point 6 draw two lines to the corners 4 and 5. Through each of the points 7 and 8, where these lines intersect the curve lines, draw a perpendicular line to the line E, at 9 and 10, and a geometrical figure will be constructed, containing points that, put in perspective, will be a guide for drawing the curves. The perspective positions of the points 9, 6, 10 (on E) must be found on the line B, in a similar manner to the points 11, 8, 12, in Prob. VI. The line D, drawn from the point 3, regulates the perspective height of the points of the arches; and to find the perspective positions of the points from which the curves commence, their geometrical height must be marked on the line A, as at the point 11; and from this a line F must be drawn to the vanishing point: this line, where it intersects the perpendicular lines drawn from the points *a* and *b* (line B), gives the points corresponding to the points *a* and *b* of the geometrical drawing; and where the line D intersects the same lines (drawn from *a* and *b*, line B), it gives the points corresponding to the points 4 and 5 of the geometrical drawing. The perspective points 9, 6, 10, on the line B, must now be carried down by perpendicular lines to the line F, and from the point 6 (on F) two lines must be drawn to the corners 4 and 5: this completes the perspective drawing of the straight lines of the geometrical figure, and through the corresponding points the curve must be drawn. The point 12 (the height of the bottom of the windows) must now be marked on A, and from it a line G drawn to the vanishing point: where this line G passes between the two perpendicular lines drawn from *a* and *b* (line B), representing the sides of the window, it gives the perspective line of the bottom of the window. The farther window is drawn in a precisely similar manner to the nearer one, finding the geometrical points on the line E, between *e* and *f*. All the lines necessary for drawing this second window are shown, but without references.

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* Throughout this problem the student must constantly refer to Prob. VI. Although the figures and letters vary, in this, from those used in the sixth problem, still the principle is the same; and it would occupy too much space to go over the same ground in every problem: moreover, by changing the references, and giving more general explanations, it will oblige the young student to exert his faculties.

The mode of drawing the doorway is similar to that used for representing the windows. The point 13, the geometrical height of the point of the arch, must be marked on A, and a line H drawn from it to the vanishing point, to fix its perspective height, as the line D does that of the windows: and the point 14, the geometrical height of the points from which the curve lines commence, must also be marked on the line A, and from it a line J drawn to the vanishing point, to determine their perspective height, as the line F does those for the points where the curves of the windows commence.

The geometrical form of the arch of the doorway must now be drawn on the line B, between *c* and *d*, in a precisely similar manner to that of the window between *a* and *b*, and the corresponding points found on the perspective drawing, between the lines H and J, as the points for the arch of the window were found between the lines D and F.

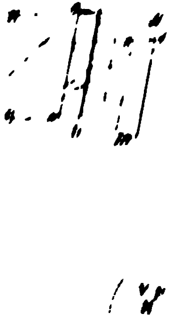
The student must understand that these pointed arches, like the semicircular ones in Fig. 2, Prob. VI., might be drawn quite as correctly in perspective, by making the geometrical drawing of the arch at the side of the line A, between the points 3 and 11; observing, that the points 7 and 8 (like the points *a b*, Fig. 2, Prob. VI.) must be found by a horizontal line passing through them, instead of two perpendicular lines. The point that would thus be found, is represented at the point 15 on the line A; and from it a line is drawn to the vanishing point, to show the student that the intersections through the points 7 and 8 are similar to those given by the intersections of the perpendicular lines.

The points here given are usually found sufficient for drawing the curves of pointed arches; but where great nicety is required, or the arches are very long and pointed, additional points of intersection may be chosen. Fig. 2 represents a narrow pointed or lanciform arch, in which the points 1, 2, 3, 4, and 5 represent the points found in the foregoing example; but other lines are here drawn, by

[illegible]

Fig 1

Fig 2.



giving intersecting points* on the curve lines, as 6, 7, 8, 9. These additional lines the student would find no difficulty in putting in perspective.

CHAPTER IV.

Having led the student by degrees to represent in perspective various superficial forms, and we trust in a manner sufficiently explicit to enable him to clearly comprehend what he has gone through, we must now proceed to the representation of solids—or, in other words, to draw the objects with their thicknesses. It was observed at p. 13, in reference to the first object put in perspective, the door, that its edge or thickness would have been seen, but that it was purposely omitted, to avoid embarrassing the student, at the commencement of his studies, with a complicity of lines. In Prob. I. (Chap. II.), four windows are drawn on the side of the house; but they represent only the superficial form, or outer line, of the space to contain the window. We will therefore proceed, with this example, to point out the mode by which the width of the recesses of the windows is found; and, to make the reference more clear, the figure is represented on a larger scale. The lines are drawn in the direction of the vanishing points; but from our limited space the points are out of the picture.

Problem X.—The student must now take his drawing of the first problem; and if he has followed the directions given in a note, in drawing it, he will have put in ink all the lines representing the *object to be drawn*. If this is done, he must rub out all the pencil lines, letters, and figures, excepting the horizontal line, the vanishing points, and the point of distance. To proceed :—

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* Horizontal lines, for getting the points of intersection, are here employed, as, from the narrow form of the arch, perpendicular lines would be more confused, especially in a perspective representation.

First, on the left side of the line 1 of the upper and nearest window, take a point to mark the width of the recess by eye,* and through this point draw a perpendicular line 2 from the top of the upper window to the bottom of the lower one. The upper window being considerably above the eye of the spectator, would cause the width of the recess to be seen below the top line, 3. To find this perspective width, a line must be drawn from the point 4 to the vanishing point G, to intersect the line 2 at 5; and through the point 5, in the direction from the vanishing point H, a line A must be drawn to meet the near line 6 of the window, at the point 7. This represents the width of the recess for the window at the top and right side, where only it could be visible to the spectator.

In the first lower window, a line must also be drawn from the upper right-hand corner to the vanishing point G; and through the point where it intersects the line 2, a line must be drawn in the direction from the vanishing point H, to meet the line forming the left side of the window: this gives the perspective width of the recess at the top. From the upper part of this window being so much nearer to the horizontal line than that of the window above, the student will perceive how much narrower the recess appears. The bottom line of the lower window being below the eye, the width of the recess will be seen below, as well as above: from the lower right-hand corner of the under window, therefore, a line must also be drawn to the vanishing point G; and through its point of intersection with the line 2, a line must be drawn from the vanishing point H, to meet the left-hand line of the window; which will complete the representation of the thicknesses of the top, bottom, and side of the recess of the first lower window. The student will observe, that the upper and lower line of the under window being nearly equidistant from the horizontal line, the perspective width of the recess is nearly equal, above and below.

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* It would be easy to find a line for getting the perspective width of the recesses corresponding with the line by which the width of the outer line of the windows was found; but the mode here given is equally correct, and more simple.

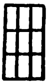
To find the perspective width of the recess of the farther upper window, the application of the rule is changed. In the first window, the width of the top of the recess is found from the line giving the width of the side; in the farther window, the width of the side is found bv the line designating the width of the top.

The line A being continued through the farther window, denoting the perspective width of the recess above, a line must be drawn from the upper right-hand corner to the vanishing point G, and, from its point of intersection with the line A, a perpendicular line must be drawn down to the bottom line, which should be continued down through the lower window. This perpendicular line gives the width of the recess at the side, and the line A gives it at the top. The width of the top, bottom, and side of the recess of the second lower window is found as in the first lower window.

The rule here given for finding the width of these recesses, is applicable to all other objects represented by straight lines. Suppose the object required to be drawn in perspective was a church tower with battlements at the top, the perspective width of the battlements, and their distances one from another, would be found in a similar manner to the position and width of the windows in Problem I., from the lines R to D, and the width or thickness of them by the rule just given. Also the perspective width of doorways, &c. with their thicknessos, may be found in the same manner.

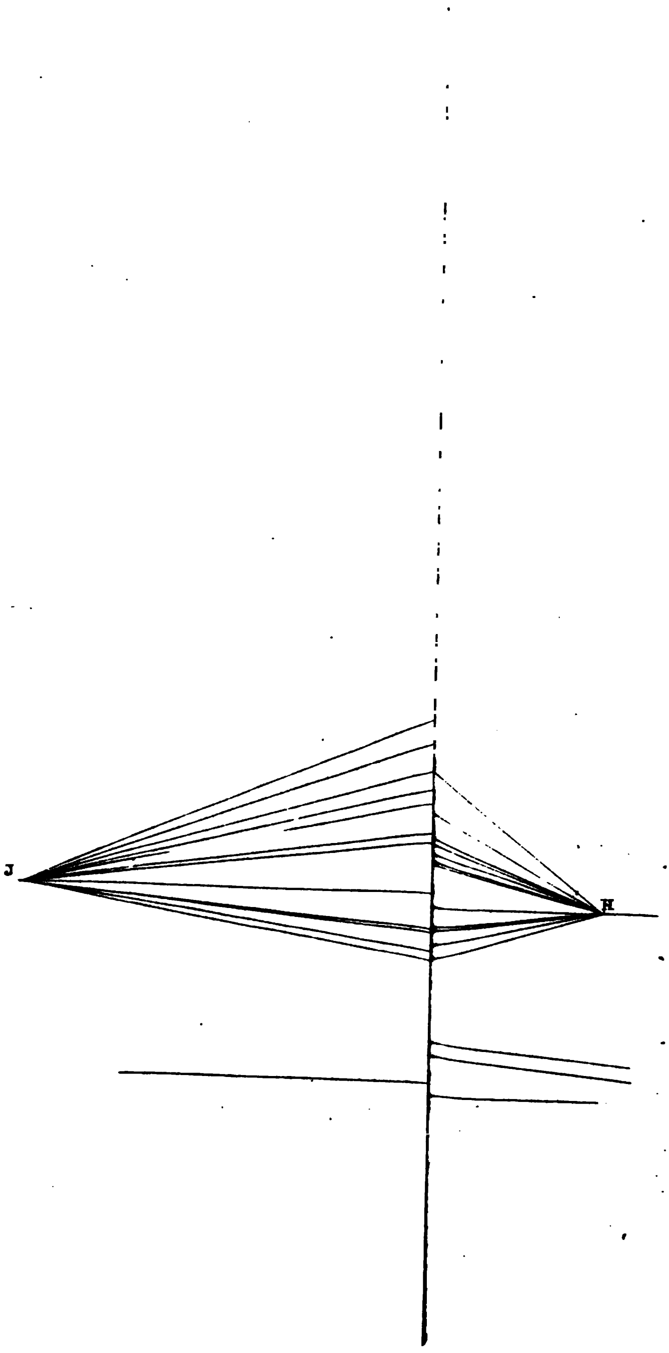
Let us suppose that each of these windows contains nine panes of glass: they would, in addition to what is already drawn, require two perpendicular and two horizontal lines to complete the frame-work (Fig. 22), which would be within the inner lines of the recess of the window. To find the perspective position of these lines, it will be necessary to have all the four inner lines of the recess drawn in perspective: we must therefore continue our drawing as if the building were transparent. From each corner of the window a line must be drawn to the vanishing point G (that from the corner 4 has already been drawn, to find the point 5 and line A); the line A must now be continued upwards till it meet the line B at 8; from the point 8 a perpendicular line must be drawn till it meet the line C at 9; from the point 9 draw a line to the vanishing point H, which will intersect the line D at 10, the same point at which the line D intersects the line 2. The lines between the points 8 and 9, 9 and 10, 10 and 5, and 5 and 8, represent in perspective the inner parallelogram of the recess of the window, in which the framework is to be drawn.

Fig. 22.



To avoid a confusion of lines and references, this figure of the window is drawn at the side, and marked Fig. 2. It is drawn of the same size, and the points are in the same relative position.

The most simple and quickest mode of putting the lines of this framework in perspective, is, first, to draw a horizontal line to the right of the point 8 (the top of the nearest line of the figure), and from the distance-point, through the point 5, draw a line to intersect it at 11. The space between 8 and 11 here represents the geometrical length of the line 8—5. Divide the line 8—11 into three equal parts (to represent the width of the three panes of glass), and get the perspective positions of their points of division on the line 8—5, from each of which points draw a perpendicular line to the line 9—10. These will give the perspective positions of the perpendicular lines of the window-frame. The line 8—9 must now also be divided into three equal parts (to give the height of the panes of glass); and from each point


J
H

of division a line must be drawn to the vanishing point H. These lines, where they pass between the lines 8—9 and 5—10, represent in perspective the horizontal lines of the framework of the window.

The student will observe, that a portion both of the horizontal and transverse lines of the framework would not be visible. The dark lines represent the parts that are seen. It is most essential to attend to this rule, as any inaccuracy in representing windows of a similar form is most offensive to the educated eye. Any number of lines forming the framework of a window may be drawn by the same rule; and it would be quite as easy, though a little more complicated, to make the lines representing the framework double; the object here, however, is solely to exemplify the rules sufficiently to enable the student to draw other similar and more intricate forms by them.

The framework of the other windows may be drawn in the same manner, but, to save time, the perpendicular lines of the upper windows may be drawn through to the lower ones.

PROBLEM XI.—Of the double arch, here given, the front one is drawn in the same manner as the first arch in the plate, Prob. VI. It varies in its proportion, but the mode of drawing it is the same.

We will endeavour so to figure and describe the representation here given, as to enable the student to draw it with the least possible difficulty. He must first imagine the object he is representing to be transparent; most perspective drawings are made as if such were the case; and he must understand, that in order to get the lines that represent the thickness or width of the object, the whole perspective drawing of the front is repeated a little way behind it, at its perspective distance. To render this problem perfectly intelligible, the lines of the front of the structure will have their references in capital letters; and the corresponding lines in the drawing behind it in small letters. The references by figures will be the same in the corresponding points of each archway.

The mode of drawing the front face of the structure, it is quite superfluous to go over; the student can draw it from the description given for drawing the first archway in Prob. VI. We will therefore consider the whole of the front or face of the structure as drawn and lettered, and proceed at once to the farther one, representing the thickness or width of the arch and side. From the points 1 and 2, the top and bottom of the line A, draw two lines to the vanishing point H, and between them draw the perpendicular line *a*, to determine the width of the structure. It is here made very narrow, for the purpose of showing a greater portion of the inner curve. From the points 1 and 2 of the line *a*, draw two lines, *b* and *c*, to the vanishing point J; and from the points 21 and 22, the upper and lower points of the line G, draw two lines to the vanishing point H; from the point 21, where the upper line intersects the line *b*, draw a perpendicular line *g*, to meet the point 22, where the lower line intersects the line *c*. This will complete the external lines of the second archway; the lines *a*, *b*, *g*, *c* of the second corresponding with the lines A, B, G, C of the first archway.

To find the line determining the top of the second arch, draw a line from the point 3 on A to the vanishing point H; and from its point of intersection on the line *a* at 3, draw a line to the vanishing point J, which is the line *d* required. To find the line determining the height of the points from which the second arch rises (4 and 5 of the geometrical drawing), from the point 15 on A draw a line to the vanishing point H; and from its point of intersection on *a* at 15, draw a line to the vanishing point J, which is the line *f* required; the line *d* of the second archway corresponding with the line D of the first, and the line *f* of the second corresponding with the line F of the first.

From the points 13 and 14 on the line D, draw two lines to the vanishing point H; and from their points of intersection at 13 and 14 on the line *d*, draw two perpendicular lines to meet the line *c*: these lines represent the two sides of the arch; and where they intersect the line *f* will be the points 16 and 17, corresponding with the points 16 and 17 of the line F. The corresponding points to 13 and 14 on D, and 16 and 17 on F, of the first archway, being found on the lines *d* and *f* of the second, there remain only the points 18, 19, 20 on F of the first, to find on *f* of the second. The student will recollect that these points were found in the first archway by getting the perspective distances on the line B of the points 11, 8, 12 of the elevation on E, and from these points on B drawing perpendicular lines that meet the line F at 18, 19, and 20. Now, from each of the points where these lines intersect the line D, draw a line to the vanishing point H, and from each of the points where these lines drawn to H intersect the line *d*, draw a perpendicular line to meet the line *f* at the points 18, 19, 20. From the point 19 *f* draw two lines upwards, one to the point 13 on *d*, the other to the point 14 on *d*; and the straight lines of the elevation on the line E are represented in perspective between the lines *f* and *d* of the second archway, corresponding with those of the first between F and D. The second curve must be drawn through the points corresponding with those of the first. The student must here understand, that the line *b* corresponding with the line B, the line *d* with D, and *f* with F, the perspective positions of the points 11, 8, 12 of the elevations might with equal correctness have been transferred from either of the three lines of the first (B, D, or F), to its corresponding line of the second (*b*, *d*, or *f*), by ruling from each point on either line to the vanishing point H, to give the intersections on the corresponding line: the lines D *d* were chosen as the most convenient, for, as they form the upper line of the figure for constructing the arch, the taking them obviates any unnecessary length of line, which is always desirable.

It would be quite superfluous to give a plate representing the gothic arch and windows, with their thickness or width, as the mode of drawing them is line for line with the example just given; but the student is strongly recommended to draw them, and, for the sake of practice, to draw another double structure of them, some little distance behind the first—say, at the distance of the point 1 from the point *d* on the line E, Prob. IX. He will find this extremely simple, inasmuch as the points (refer here to the problem just gone over) for the perspective distances of the points 4, 11, 8, 12, 5, and 9 and 10, are already found. We will explain this by continuing the problem before us. Continue the line *c* (the base-line of the farther side of the first structure) to the ground line, at the point 21; the space between 21 and the bottom of the line A (2) will represent the geometrical width of the structure; the vanishing point J serving as a point of distance for the objects on the right-hand side. From the point 21 measure off on the ground line, to the right, a space the length of the line E, to represent the geometrical distance of one structure from the other (any other distance might be chosen); and farther to the right, measure off the space between the points 2, the bottom of the line A, and 21, to represent the width of the second structure. From each of the points of division, rule a line to the vanishing point J (as a point of distance), and from the intersections of these lines with that drawn from the lower point (2) of the line A to the vanishing point H, draw two perpendicular lines to meet the line drawn from the top of the line A to the vanishing point H. This will give four points in the second double archway, corresponding with the points A 1, *a* 1, and A 2, *a* 2, and represents the sides of the second archway. The corresponding lines of this archway, as far as we go, are lettered and figured the same as in the first, to make them perfectly intelligible. The line already drawn from the point 3 on A of the first structure, gives the points 3—3 on the lines A *a* of the second; and from these points the lines D *d* are ruled to the vanishing point J. The line ruled from the point 13 on the line D of the first structure, to get the point 13 on *d* of the same, gives the points 13—13 on the lines D—*d* of the second; and all the lines drawn from the points on D, to find the corresponding points on *d* of the first, in their passage to the vanishing point H, give the corresponding points on the lines D *d* of the second structure, and would to any number it were necessary to draw. The line drawn from 15 A of the first, gives in like manner the points 15 A and 15 *a* on the second; and the lines F *f* are ruled from these points to the vanishing point J. The above is quite sufficient to enable the student to complete the drawing of the second double archway; and the gothic archway and windows may be represented in precisely the same manner.

The student must now refer back to Plate VIII., Prob. VII. Fig. 3, here given, is a fac-simile of Fig. 2, with the width of the arches added. Nothing can be more simple than to make this addition, as it is merely repeating what has been done before. The second figure is chosen on account of its showing more of the thickness of the arches; but the mode of adding the width to the arches in either of the figures is the same. The student had better, perhaps, commence with Fig. 1, on account of the references. In this case, from his being situated exactly midway between the two sides of the arch, he must necessarily see the thickness on both sides. The width of each arch is supposed to be one-third of the space between the two sides: take, then, one-third of the distance from A to B, and put it on the ground line to the right of the point 2, as at *d*, and from it rule a line to the point of distance; from the point where this line intersects the line D draw up a perpendicular line till it meet the line C; from the point where the perpendicular line touches C draw a horizontal line to the line E, and from that point again draw a perpendicular line to the line F. From the middle point of the horizontal line drawn from C to E (given by the intersection of the line drawn from the point

5 to the vanishing point) describe a semicircle from its two extremities, and the drawing of the thickness of the first archway will be completed. The student will doubtless perceive that the mode here pursued for representing the width of the archways, is precisely the same as that before described for drawing the second archway. To get the thickness of the second archway, set the geometrical width (one-third of the distance from A to B) on the ground line, to the right of the point 4, find its perspective width on the line D, and proceed, as with the first, and so on, from the geometrical width beyond the points 11 and 12, for the third and fourth archways. The widths of the archways in Fig. 3 were drawn in the same way.

We have, in Problem IV., pointed out the utility of diagonal lines for finding the perspective centres for gables, &c., as also for determining certain perspective distances There is another and most essential use of this rule; which is, the finding the points of spires, turrets, &c., whether their basis be of a square, circular, or other form. If a pyramidal figure, the base of which is a square (Fig. 1, Plate XIII.), the square must first be put in perspective, its centre found by diagonal lines, and from the centre a perpendicular line D drawn up to the height of the top of the pyramid E; and to this point, from each of the angles A, B, C, a line must be drawn, which will give the true representation of a pyramid in perspective. Where this rule is applied to the drawing of spires, from the height of the tower, the sides of the square generally incline downwards to the vanishing point; but it is immaterial whether the perpendicular line D, to find the point of the spire, be drawn up from the centre of the upper or lower square of the tower. In Fig. 2, a drawing is given of the outer lines of a tower with a square spire, and the perspective squares are drawn both at the top and bottom. The student will perceive from it, that the perpendicular line D, to find the point of the spire, drawn from the centre of the lower square, passes directly through the centre of the upper one.

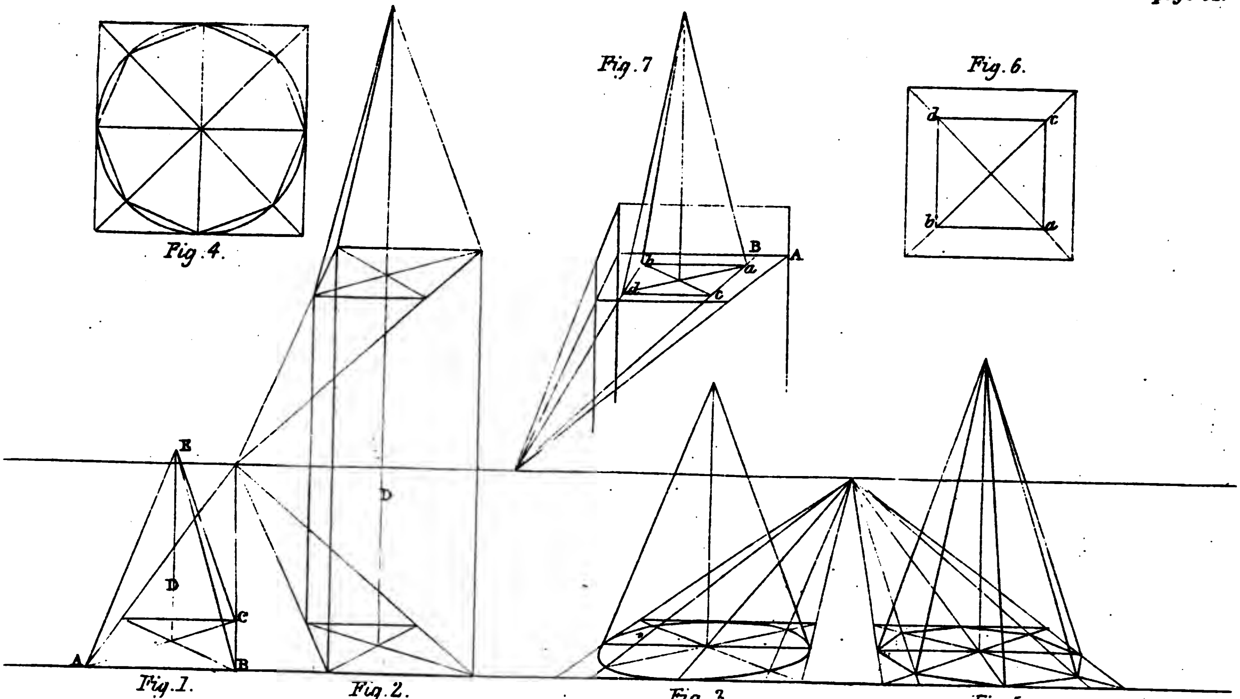


Fig. 4.

Fig. 7

Fig. 6.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 5.

In representing conical forms, the same rule is to be followed. Fig. 3 represents a cone in perspective. The perspective circle being drawn as described in the preceding problems, and the points for drawing the curve being found by means of a square, the perspective centre of the square will also be the perspective centre of the circle, from which a perpendicular line must be drawn up for the point of the cone; and from each of the lateral extremities of the circle a line must be drawn to it, which will give the perspective appearance of a cone.

Fig. 4 is a geometrical figure of eight sides, called an octagon, with the mode of constructing it. It is a similar figure to that given in Problem V. for constructing a circle; and if from point to point, through which the circle is drawn, straight lines are ruled, it will produce a regular eight-sided figure, or octagon, of which all the sides and all the angles are equal. By putting in perspective the same figure of straight lines as that given for describing a circle in Problem V., these eight points will be in their perspective positions, and eight lines ruled from one point to another will give the octagon in perspective: a perpendicular line must then be drawn up from the centre of the square (which is also the centre of the octagon), and lines drawn to it from the angles of the octagon. Fig. 5 is the representation of an octangular pyramid: in the position from which this is seen, four sides of the octagon are visible to the spectator: but it is very commonly the case, that only three sides of an octagonal tower or pyramid are visible. This depends entirely on the position in which the spectator places himself to view it.

Figs. 6 and 7. It frequently occurs that spires of churches do not commence from quite the top of a tower, and that the base of the spire is less than the square of the tower. In going to the summit of a church tower, it is very common to find, between the base of the spire and the battlements, a sort of terrace, to walk round, of from three to four feet wide, and that the walls of the tower rise three or four feet from this platform. Fig. 7 represents the upper portion of a structure of this kind.

Fig. 6 is a diagram representing the plan of the square of the tower, with the square of the base of the spire within it: such a figure is technically called a drawing of concentric squares. The student will observe, that in this diagram the diagonals drawn from the corners of the outer square form the diagonals of the inner one, and would form the diagonals of any number of squares, when their sides are always at an equal distance from the sides of the outer one. Concentric squares, then, may with great facility be represented in perspective; for the outer square being put in perspective, and the diagonal lines drawn, any one point of an inner square being found on either diagonal line, the three remaining points can readily be found from it. In Fig. 7, suppose A to be the distance of the platform below the top of the tower; at this height a square must be drawn, with its diagonal lines. Let B represent the distance of the base of the spire from the outer wall of the tower; from it rule a line to the vanishing point, and where it intersects the diagonal line at *a*, will be a point for drawing the square of the base of the spire corresponding with the point *a* of the diagram. From the point *a* draw a horizontal line to the opposite diagonal at *b*, which will answer to the point *b* of the diagram. From the point *b* a line must be drawn to the vanishing point, which will intersect the diagonal beyond at *d*. The line already drawn from B has given the point *c*; a straight line drawn from *d* to *c* will be found to be parallel to the upper line from *a* to *b*, and completes the drawing of the inner square in perspective. A perpendicular line must now be drawn up from the centre of the square to the height of the spire; and to this point lines must be drawn from the points *a* *b* and *d* of the inner square, or base of the spire. The dark lines represent the perspective appearance of such a tower and spire as were proposed to be drawn. Conical, octagonal, and other spires, similarly placed, may be represented in the same manner.

It may be well here to make a few observations regarding the reflections of objects in water. Reflections in water require the same attention to be paid to the rules of perspective as when drawing the representations of the objects themselves; this must be understood to apply to reflections in still water, where their appearance is similar to the reflections in a large looking-glass. It is highly necessary that this should be attended to in sketching from nature. The introduction of water in landscape scenery greatly adds to its interest; and though it would have a bad effect generally to reflect every object on a sheet of water with the precision the objects themselves are represented, still it is well to know that such might be the case, and to be able to do it when requisite. In some of the works of the Dutch and Flemish painters, who executed their pictures for the most part on the spot—and hence their deserved reputation for truth—an occasional bit of reflection may be met with, that, if the painting were turned upside down, the reflection might be taken for the reality, and the reality for the reflection. There are a variety of circumstances that have their influence on the appearance of reflections; such as ripples, currents, &c., all of which, fleeting as they may be, are turned to advantage by the observant and skilful artist. A judicious observation on the influence twilight produces on reflections, frequently has a fine effect on a picture; much of positive form is lost in the mysterious appearance of objects between the spectator and an evening sky, though the forms of these objects are often vigorously reflected in the water. These remarks, though somewhat foreign to our purpose, we are led to make to caution the young aspirant from adhering too much to rule. Though a bit of real reflection, judiciously introduced here and there, has an excellent effect, to reflect every object as if it were standing on a magnified mirror would have a very bad one.

It very commonly occurs that parts of a building, or other object, that are not visible to the spectator, are shown in the reflection, and also much is visible to the spectator that in reflections cannot be shown: this applies principally to horizontal surfaces; as, for instance, if a square post were represented standing in the water, the flat of the top would be visible, but there could not by any possibility be any reflection of it; but if a succession of posts, with railings running from them, as is constantly met with across country streams, for preventing cattle straying, the *upper* side of the rail would be visible, but the *under* part would be shown in the reflection. These apparent trifles should be carefully attended to; the introduction of objects of this kind gives a local truth to a landscape, and they are frequently invaluable as bits of foreground. When this occurs, they form necessarily a large feature, and any want of accuracy is easily detected. Thus, in Fig. 23, a bit of brick wall, with the coping, the top of the coping is seen in the object, but in the reflection the under part of it is shown. All the horizontal lines of this diagram, both of the object itself and of the reflection of it, tend to the same vanishing point, as is shown very distinctly in the lines dividing the rows of bricks forming the wall, which are drawn in precisely the same manner as if the wall and its reflection were one plain surface. It will be well to bear this in mind, as want of thought sometimes causes some to draw the reflections in the water exactly the reverse of what the objects appear, which in many instances is a gross error, as is shown in the example (Fig. 24), where the difference between the object and its reflection is very considerable.

Fig. 23.

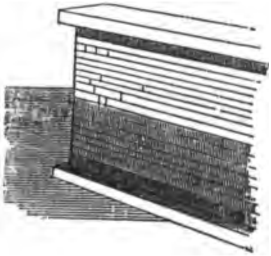
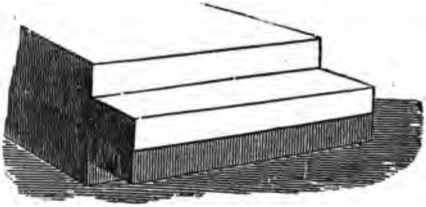
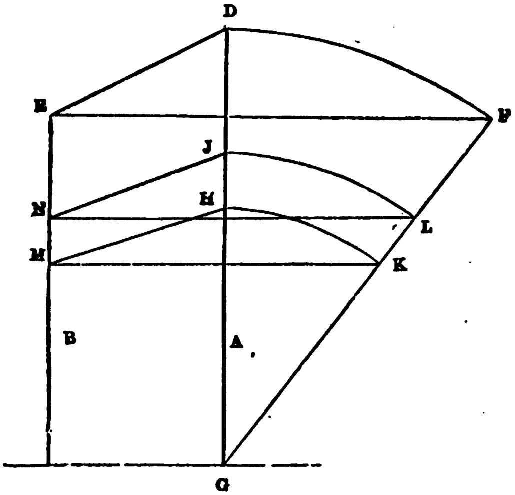


Fig. 24.



As it is with reflections, so is it with shadows; they must also follow the same rules of perspective as the various objects that cast them. In all ordinary perspective drawings, the shadows are projected as in the geometrical drawings,—which for the most part are at an angle of forty-five degrees. This is an extremely convenient way of casting the shadows, as in an elevation drawing the depth of the shadow is the same as the extent of the projection. Though, for the style of drawing to which this first part of the work is expressly devoted, it would not be proper that the light and shade should be put in according to rule, yet it is well to bear in mind, that to represent correctly the forms of shadows thrown from any projection, as the projecting roof of a house, a cornice, window-sill, &c., or shadows cast on the ground, requires as much attention to the rules of perspective, as for drawing the outlines of the objects that cast them. If the shadow thrown from a projecting roof were to be made of a greater depth at the further angle of a building than at the nearer one, it would produce the effect of a wider projection at the further end, which, in representations of new buildings, would have an extremely awkward effect; on the contrary, in representations of cottages and ruins, this same knowledge is of advantage, as the inequalities in the depth of the shadows give an excellent help to the effect of dilapidations. We offer these few observations for the advantage of the amateur without illustrating them by examples, the compass of this treatise not admitting of our entering into the subject of light and shade.

There is a problem in perspective, one extremely useful in drawing very large objects—viz. that of finding the perspective inclinations of parallel lines by means of arcs of circles. It appears curious, that in order to draw the representations of curves in perspective, we are compelled to use straight lines, and that in this instance we find the proper directions of straight lines by means of curves. It occasionally happens that some object in a picture is so large, and the vanishing point for finding the proper inclination of the parallel lines so far out of the picture, that it would be difficult to find a means of drawing lines with sufficient accuracy to a vanishing point, if one were fixed; as, for instance, some high object towering above everything in the picture. This ingenious mode of inclining lines towards a vanishing point, without having occasion to make use of one, is as follows:—Let A and B* represent the two sides of the front of a tower,



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* From our limited space, we are compelled to give this diagram on a very small scale, but its peculiar advantage is when applied on a large scale. It was pointed out by a deceased artist of great celebrity, to the author, when making a very large outline of one of the towers of Rochester Castle. He has found it on many occasions of great service.

D B being the perspective inclination of any horizontal line on the face of it, and C the horizontal line. From B draw an indefinite line E F, parallel to the horizontal line C; from the point G, at an extension of the compasses G D, describe an arc of a circle till it meet the line E F at F; join F G. If the arc of a circle be drawn from any point on the line G D through the line G F, the point of intersection on it will furnish a point that will regulate the inclination a horizontal line should take on the face of the tower, drawn from the point on the line G D the arc springs from. Suppose the perspective inclination of a horizontal line required across the face of the tower from the point H; in order to find this inclination, from the point G, with an extension of the compasses G H, describe the arc of a circle till it intersects the line F G at K, and from K draw a line parallel to the horizontal line C to meet the line B at M; then join H and M, and the line H M will be the perspective inclination of a horizontal line on the face of the tower at the height H, tending towards the same vanishing point as the line D E. Take any other point on the line A, as at J; from G, with an extension of the compasses G J, describe the arc J L; draw a horizontal line from L to the line B at N, and a line drawn from J to N will be in its perspective inclination towards the same vanishing point as the lines H M and D E. By extending the horizontal line C to the left, and continuing the line D E till it intersects it, the point of intersection would of course be the vanishing point, and it will be found that both the lines H M and J N would terminate in the same point. The perspective inclinations of any number of horizontal lines may be drawn in a similar manner, and the perspective divisions of stones, battlements, windows, &c. may be found either by means of a point of distance found as described pp. 12 and 13, Plate I. Fig. 2, or by means of diagonal lines as described p. 29, Prob. IV. Plate 5. Thus the perspective divisions and inclinations of lines may be drawn on the face of a building without the necessity for a vanishing point, which in certain cases, such as being deficient of large drawing-boards, long rulers, &c., will be found of very considerable advantage.

The foregoing examples, with their descriptions, the author has commonly found ample for the generality of his pupils, mostly young ladies, whose numerous avocations leave them but little leisure for the study of what they mostly consider so dry a subject as perspective. In sketching from nature, even by those well acquainted with the more complicated branches of perspective, it is generally found sufficient to mark the positions of the various points by the eye, without resorting to drawing ground plans, &c. and finding them by rule: nevertheless it is always desirable, if time permit, to thoroughly understand the principles upon which perspective drawing is founded, and more especially for those who propose to become teachers themselves. One principal object with the author has been so to arrange his material, that any intelligent youth, without the assistance of a master, might proceed by easy stages, from chapter to chapter, and render himself, after a diligent perusal of the whole work, competent to instruct others. By an attentive perusal of this First Part of Practical Perspective, the Second will be rendered easy of comprehension to the reader; and we shall be enabled, we trust, to take the problems used for illustrating the descriptions of the First Part, and show how the same things may be constructed from plans drawn from actual measurement in the Second.

PERSPECTIVE FOR STUDENTS.

PART II.

CHAPTER I.

Before entering into the matter of the second part of this treatise, it cannot be too strongly impressed on the mind of the student, that Perspective—that is to say, our portion of it, Linear Perspective—is the art of representing in outline the forms of objects on plane surfaces, as they appear to us when viewed in different positions; we say as they *appear*, because it must be fully understood that an object viewed perspectively never appears of its positive form. There is, however, one exception to this rule, that of a sphere; this figure, viewed from whatever position it may, near or far from it, above or below it, appears always of the same form. There are certain positions in which objects are viewed, that, whatever their distance may be from the spectator, they retain their geometrical figure, the apparent size only changing according to the distance; such would be the case in any plane figure viewed in the direction of Figs. 7 and 8, Part I. p. 7, and Fig. 11, p. 8, *id.;* which, at whatever distance they may be removed from the spectator, always appear of their geometrical form: objects viewed in such directions cannot be said to be in perspective. We may then really define Linear Perspective to be the art of representing certain forms by other forms dissimilar to those they are intended to represent, and yet conveying to the mind a perfect idea of the object intended. Thus a circle, unless perpendicularly opposite the eye, never appears a circle, but always as an ellipse;* and a cube, which everybody knows to be a figure of six equal sides, each face being a perfect square, may be represented by a figure in which no two lines form a right angle, and yet convey the perfect idea of a cube, as in the following example, which represents the form the outline of a cube would assume, as viewed from a certain position. This figure filled up with the intermediate lines, shaded, and certain round marks on it, will convey at a glance the idea of an object familiar to most individuals.

Fig. 1.

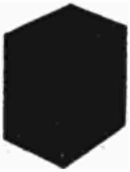
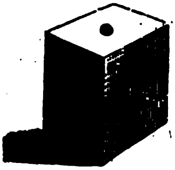


Fig. 2.



Let us first inquire how it is that objects viewed perspectively, apparently change their figure. A very slight observation of the appearance of real objects must convince any thinking person, that any object whatever, when seen from a distance, appears smaller than if it were close to him, and that the farther it is removed the smaller it appears. Were this not the case, how, when sitting in a room, could we account for seeing the houses on the opposite side of the street? If the houses, from their distance, did not appear reduced in magnitude, it would be impossible to see even one of them through so comparatively confined a space as that occupied by a window. To illustrate this, we introduce a light sketch made from the spot at which we are now pursuing our labours, seated about three feet from the window.

In this cut we see that the whole of a house on the opposite side of the street, from its greater distance from the spectator than the window through which it is seen, appears only

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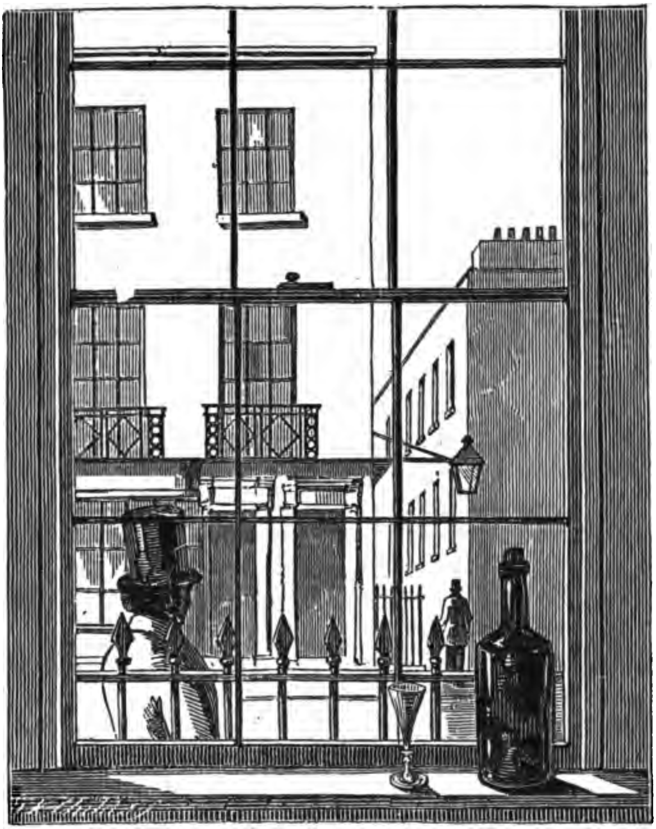
* When placed horizontally at exactly the height of the eye, it appears as a straight line. See Fig. 13, Part I. p. 8.

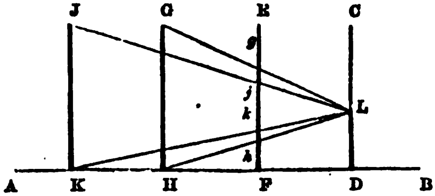
Fig. 3.



of the height of about two panes of glass; we perceive that a large projecting lamp from the corner of the opposite shop, appears much about the size of the bowl of a wine-glass situated on the window ledge; that the full height of a figure under the lamp, from its distance, is scarcely higher than the crown of a man's hat close to the railings in front of the window, and much less than a bottle standing by the side of the wine-glass within the room. Though we have every reason to believe the first-floor window of the house opposite to be fully as large as that through which we are looking at it, yet from its distance it occupies but a small portion of a single pane of glass of that so close to us; in fact, this cut must in every part clearly demonstrate the fact of objects appearing smaller as their distance is increased.

The following very simple experiment will perfectly satisfy the most incredulous as to the fact of objects of an equal size appearing less and less as they recede from the spectator, and the diagram will prove very serviceable in our progress. On the wall, or on a large piece of board, draw a long straight line, similar to the line A B in the following diagram;

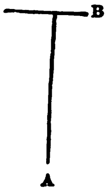
Fig. 4.



and on it draw four perpendicular lines at equal distances one from the other, say each line eighteen inches in height, with an interval of one foot between each, similar to the lines C D, E F, G H, and J K. Drive a nail into the top and bottom of each of the lines G H and J K, and to each nail attach a piece of twine; then taking the four strings together, draw them tight, and bring them to a point anywhere on the line C D, as shown in the diagram at L. If the eye be now placed at the point where the four strings meet on the line C D (as shown at L), and the line E F taken as a line for the measurement of the two more distant ones, the line G H will appear of the length *g h*, and the line J K will appear of the length *j k;* clearly showing that lines of the same length appear less and less as their distance is increased. It may be here noticed that this apparent diminution in size according to distance, is in a regular progression; that a line placed at a certain distance from the spectator, at double that distance will appear exactly half the length it appears in its first position: thus, G H, viewed from the point L, appears exactly half its length, *g h* measuring precisely one-half of E F.* At three times the distance, it will appear exactly one-third the length it appears in its original position; thus, J K, three times the distance of E F from C D, viewed from the point L appears one-third the length of E F, *j k* measuring precisely one-third of this line. At four times the distance, it would appear one-fourth; at fives times the distance, one-fifth, and so on progressively.

We may venture to presume, then, that no doubt remains in the mind of the reader that objects do really appear to diminish as their distance from the spectator is increased, as on this fact we propose to show how it is that objects viewed at an angle in perspective apparently change their form. Let us, for example, take the simple form of a square (any rectangular piece of board will answer the purpose), and place it upright before us; the relative positions of the spectator and board being as A B (Fig. 5); A representing the position of the spectator, and B the base of the board, the board itself standing perpendicularly over this line; the line from A to B representing the direction in which the board is viewed. In such a position, the simple geometrical form of the square (or whatever form it may be) would be apparent,

Fig. 5.



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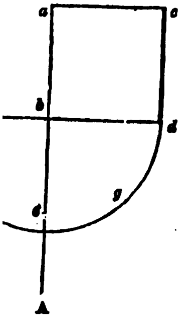
* If the strings were brought to a point on any other part of the line C D, the result would be the same.

s would be the same at whatever distance it may be l, so long as the board stands at a right angle with the ı of the line from A to B in which it is viewed; the of distance affecting only the apparent size of the ›ut the form always remaining the same: but if the which the board stands with reference to the line from s in the slightest degree changed, an apparent change is the immediate consequence, as we will endeavour to ɩt by the following diagram (Fig. 6). In this figure, let the square *a b c d* represent a closed shutter, opening by hinges on the side *a b*, viewed from the point A in the direction A *e b*. If this shutter were opened, so as to lay it against the wall to the left, the edge *d c* must necessarily describe a semicircle in its passage from *d* to *f*, as shown by the line *d e f*. In the passage of this shutter from its first position, closed over the line *d b*, to its full opening over the line *b f*, it an infinite variety of forms. In its first position we utside, and in the last the inside, of the shutter; and h these positions the shutter stands at a right angle direction of the line (A *e b*) at which it is viewed, it ›pear of its simple geometrical form either shut or Tow it must be quite evident that as in the first the outside is visible, and in the latter the inside, st be in its passage from *d* to *f* one position in which de could be seen, but merely the edge of the shut- this would occur when the line *d c* comes imme- ver the point *e*, the point immediately opposite the ıe spectator at A. Such being the case, it follows the passage of the edge *d c* towards *e*, the ›ween the two sides *d c* and *a b* must gradually

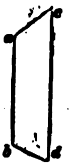
Fig. 6.



appear to become narrower and narrower, till it is at last entirely lost to view: and by the same reasoning, the shutter having passed the point *e* towards *f*, the inside when it first becomes visible appears extremely narrow, and gradually appears wider and wider till it comes to its place against the wall over *e f*, where it resumes its real geometrical form.

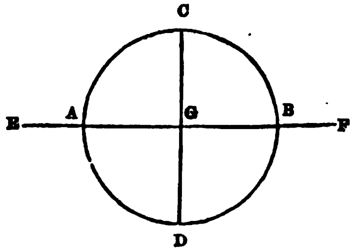
Let us open the shutter as far as the point marked *g*, and examine what form the square shutter would assume in this position. The side represented by the line *a b* remains stationary in all the variety of positions, but that represented by *d c*, when brought to the point *g*, from its being brought nearer to the spectator, would appear longer; and as we have shown that in the passage of the shutter from the point *d* towards *e*, the space between the two sides becomes apparently narrower, it would, when standing over the point *g*, require to be drawn closer to *a b* than in the diagram (Fig. 6). The appearance then of the square shutter *a b c d*, opened as far as the point *g*, would be as shown in Fig. 7; the line *a b*, from its remaining in the same position, is drawn of the same length as *a b*, Fig. 6; but the line *c d*, from its being brought nearer to the spectator, is drawn longer: and as the space between *a b* and *c d*, for the reasons before given, is apparently less than in Fig. 6, it is drawn nearer to *a b* than in that diagram. The top and bottom of the shutter must be drawn by joining the points *c a* and *d b*; and this figure, *a b c d*, notwithstanding the difference of its appearance from the original form, is nevertheless a correct representation of what a square would appear in the position we have described, and with the addition of light and shade would convey a perfect idea of the object it proposes to represent.

Fig. 7.



The following diagram (Fig. 8) will enable us to understand how it is that a circle must necessarily change its apparent form according to the point from which it is viewed.

Fig. 8.

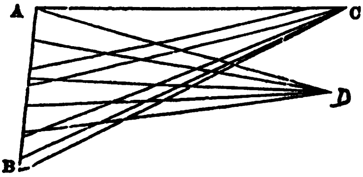


Suppose the circle A B C D to represent a hoop standing upright, and the eye of the spectator exactly opposite the point G; the line E F an axis on which the hoop may be made to revolve: the hoop might be turned upon this axis so as to bring the point D before the point G. In this position, the curve of the circle would appear a part of the straight line E F. Now on the same principle that the shutter appears to become narrower and narrower in its passage from *d* to *e* (Fig. 6), the space from D to G must appear gradually to lessen in width in the change of the hoop from a perpendicular to a horizontal position, and the line D G consequently appear to shorten till it becomes apparently a mere point. The centre of a circle is a point within the circumference equidistant from all parts of it, and all lines drawn from this centre to any part of the circumference are of equal length, as is the case in the geometrical figure before us, G A, G B, G C, and G D being all equal; but the instant the hoop is turned upon the axis, the figure becomes totally changed; the point D is brought forward, and the point C thrown behind; D G appears shorter, C G, from being further removed, shorter still, and A G and B G remain the same. If the hoop be turned completely round upon the axis, the diameter A B is always the same, but the diameter C D is always apparently changing, producing a constant apparent variety of forms. Hence it is clear that the apparent change in the form of an object arises from the increased or diminished distance of one part from another; so that what is required to enable us to represent any object, or combination of objects, in perspective, is to find the relative heights and distances of the different parts according to the angle at which they stand in reference to the spectator.

CHAPTER II.

The rules of perspective are deduced from the science of optics, depending on the fact of vision being caused by rays of light passing from the object seen into the eye, and forming an image at the back of it, similar to the reflection of an object in a mirror. These rays of light forming the image are supposed to proceed from the object in straight lines, and in every possible direction, as shown by the lines proceeding from the line A B (Fig. 9). It will be clear from this diagram, that the same rays that give the representation of the line A B to a spectator situated at C, cannot be the same as those that give the representation to a spectator situated at D. It is by means of lines drawn from the object to the eye of the spectator, that the perspective positions of the various points are found; these lines are called visual rays, and in their transmission from the object to the spectator pass through an intermediate plane,* called the plane of delineation (to be

Fig. 9.



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* Many are deterred from commencing, and more from persevering in the study of Perspective, from the multiplicity of definitions too frequently put at the very commencement of most works on this subject, as if it were purposely done to frighten the young student from his pursuit; still, certain technicalities are unavoidable, such as the point of sight, the vanishing points, &c.: the ground plane, horizontal planes, perpendicular

hereafter described), and there determine the size and form the object must take in the representation.

Much difficulty is always avoided by clearly comprehending every step we take in the pursuit of knowledge; let us then understand that the cause of vision is the rays of light coming from the object to which our eyes are directed, passing through the pupil of the eye to the back part of it, and there forming an image representing every object on that small space in the most exquisite perfection.* The rays of light are supposed to proceed from all objects in straight lines, and in every possible direction. Now if our object be only the representation of one single straight line, notwithstanding the rays of light proceed from every part of the line we are about to draw, and in an infinite variety of directions, all that we require for finding the position of this

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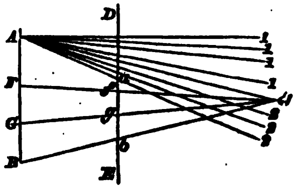
planes, parallel planes, &c. are terms so commonly in use that an explanation of them is indispensable. Some of these technicalities it is to be hoped are already understood from the perusal of Part I. of this treatise; others we will endeavour to explain as the necessity for using them occurs; for the present we will only observe, that the word plane is used to designate a surface; thus the ground on which objects stand is called a plane (the ground plane); the surface of glass interposed between the spectator and the subject is also called a plane (the plane of delineation) &c. &c.

* The optic nerve, the supposed medium by which the image is conveyed to the brain, is expanded at the back of the eye into a beautiful transparent membrane called the retina, at the back of which nature has spread a dark pigment, forming a most perfect concave mirror, and on this minute surface a most perfect representation is formed of everything within the scope of vision. To understand clearly how this wonderful miniature image of all that we see is represented on the retina, would require a knowledge of the anatomical structure of the eye, as well as some proficiency in the science of optics; the form of the eye, of the lens, or crystalline humour within it, and the density of the humours both in front and behind the lens, all have an influence on the direction of the rays of light, so as to bring them to such a focus as will produce the image. All that is required for our purpose is to understand that the rays of light do proceed in straight lines from every object we see, to the eye.

line in the picture are the two rays from the extremities of the line; by these alone we are enabled to determine the perspective position of the two points from which the rays proceed on the paper or canvas, when a line drawn from point to point must be the representation of the straight line.

In Fig. 10, let A B represent the line to be drawn, and C the position of the spectator's eye; from A a number of straight lines are drawn, to represent the rays of light proceeding in various directions from this point: and it must be evident that none of the rays proceeding in the direction of the lines A 1, A 1, could possibly reach the eye of a spectator situated at C, neither could any of the rays proceeding in the directions A 2, A 2. It is sufficient to draw a line from A to C and from B to C to determine the position of the two points on any intermediate line, as D E (which would represent a perpendicular section of the plane of delineation); and from A to B, being a straight line, no intermediate points would be required, as all straight lines are represented by straight lines; thus, supposing D E to be the distance from the spectator at which the representation is to be made, or, if we express ourselves technically, suppose D E to be a perpendicular section of the plane of delineation, the intersections on it, *a b*, would represent the position of A B; and though from every portion of the line A B it is understood that rays are proceeding to the eye, it is unnecessary for perspective drawing to introduce them. The visual rays F C and G C, which give the points *f* and *g* on the section of the plane of delineation, are perfectly unnecessary if the line A B only is required; for A B being a perpendicular line, and D E the section of the plane of delineation, also perpendicular, the line A B must necessarily come through these points *f* and *g*. It must, therefore, be understood that in

Fig. 10.



drawing visual rays from any object composed of straight lines, it is only necessary to draw them from their extremities: thus, in drawing the visual rays to find the perspective position and form of a square, it will only be necessary to draw a visual ray from each corner; the positions of the four corners being found, the lines may be ruled from point to point, as we shall presently demonstrate.

Now perspective is said to be the art of representing an object or combination of objects on a plane, such as a sheet of paper or canvas, as they would appear to the spectator looking through a sheet of glass, or window, interposed between himself and the objects to be delineated. This sheet of glass, or window, is a most important feature in perspective drawing; and though views are more frequently taken in the open air than from a room, an intervening sheet of glass, or transparent plane, is always supposed to exist between the spectator and the original objects, and this supposed intermediate plane is called the plane of delineation.* Thus, supposing a view to have been selected for delineation, with the correct measurement of all the various parts of which it consists; before we can proceed a single step to prepare the points necessary for making a perspective drawing, the position of the spectator and the plane of delineation must be determined; the size of the objects in the representation depending on the nearer or more distant position of the plane of delineation from the spectator. Let us refer to Fig. 4, p. 76, and suppose the line J K to be the object to be represented, and L the position of the spectator's eye; either E F or G H may represent a section of the plane of delineation, but it makes a vast difference in the relative space the object will occupy in the picture, whether it is placed in the one position or the other. The lines J L and K L represent the visual rays; and it will be seen by the diagram how much longer the representation of the line would be were G H the position of the plane of delineation, than if it were placed at E F, by the different length between the intersections of the visual rays on the two lines.*

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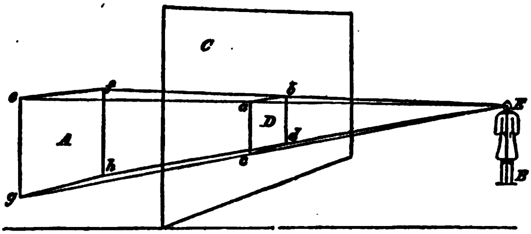
* The cut, Fig. 3, p. 75, is an excellent example of this. The house, the windows, the lamp, the figures, railings, and everything, in fact, *outside* the window from which the sketch is taken, are the objects to be drawn, or, as they are commonly termed, the original objects; we have the window through which they are seen (which may be called the plane of delineation), on which the form of all the objects might be traced—and the position of the spectator three feet from it.

We will endeavour to illustrate the preceding observations by the following diagram. Let A (Fig. 11) represent

Fig. 11.



a square to be drawn (the original object), B the position of the spectator, and C the plane of delineation; the square, the spectator, and the plane of delineation, all standing on the same level plane. The appearance of the square on the plane of delineation would be as D, and its form and position are there ascertained by means of visual rays drawn from the four corners of the original object, *e f g h*, to the eye of the spectator at E, perpendicularly over B. We have in this diagram the original object (the square), the position of the spectator, and the position of the plane of delineation, with the visual rays drawn through it; and if we could imagine these visual rays to be pieces of thread, or wire, passing through the plane of delineation, we should be able to mark the points of intersection *a b c d*, and at once draw the lines representing the square from point to point; but though we know them to pass through, we know also that they are not tangible, and we must therefore find some means to ascertain the points of intersection of the visual rays with the plane of delineation; to explain which we must have a fresh diagram.

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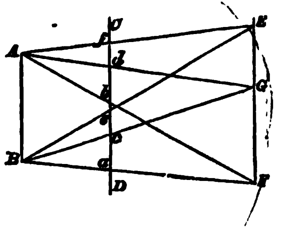
* By reference to the cut, p. 75, this may be easily understood, as, if the reader station himself first at about three feet from a window, and notice exactly how much of the opposite side of the way he sees through it, he may easily satisfy himself of the wonderful difference consequent on the slightest change of position. If the student retire three yards from the window instead of three feet, he will perceive that a much less portion of the opposite side of the way is now visible, though the window, which we will suppose to be the picture, is of the same area. Again, if the student comes quite close to the window, he will find a much greater portion of the opposite side of the way is seen. This experiment is merely to show how much a perspective representation depends on the relative positions of the spectator and plane of delineation with the original objects.

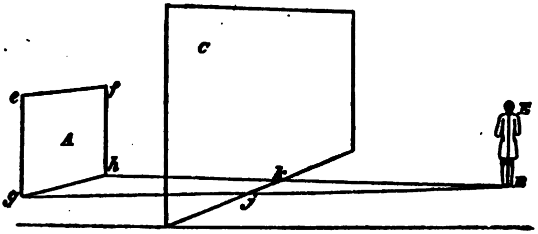
Fig. 12.



In this cut (Fig. 12), A B is the object to be represented, C D a perpendicular section of the plane of delineation, and the eye of the spectator anywhere on the line E F; for, as affects the length the line A B will appear on C D, it is immaterial at what point on this line the eye may be situated, as may be seen by the intersections made by the visual rays on C D, *a b*, *c d*, and *e f* being of an equal length. As it is with the height of an object, so it is with the width: the visual rays drawn from *e* and *f*, and *g* and *h*, to E (Fig. 11), would give the same width on the plane of delineation if drawn to any other point on the line B E. We have stated that the base of the square, the base of the plane of delineation, and the spectator (Fig. 11), all stand on the same level plane; therefore, if we suppose the eye of the spectator to be on the ground, the visual rays drawn from *g* and *h* to that point (B) would intersect *the ground line* of the plane of delineation, and these points of intersection determine the width of the square, at whatever height the representation of it may be on the plane of delineation. If from each of these points a perpendicular line is drawn from the base to the top of the plane of delineation, the space between the two lines determines the width of the square, at whatever point on the line B E the eye of the spectator may be placed; the perpendicular from either point of intersection representing a section of the plane of delineation, on which the height of *e g* or *f h* may be found in a manner precisely similar to that of finding the height of A B on the section C D, Fig. 12.

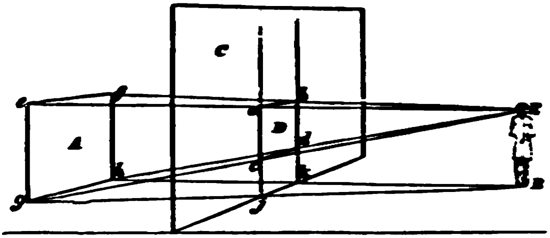
In Fig. 11, then, we have the relative positions of the spectator and object, with the interposition of the plane of delineation: the visual rays are drawn, and the points of intersection were found, in the following manner. In this diagram (Fig. 13), the relative positions of the spectator and original

Fig. 13.



object are the same as in Fig. 11, visual rays being drawn to a point on the ground plane, perpendicularly under the eye of the spectator; and the intersections of these lines with the base of the plane of delineation at *j k* determine the width the square would appear. The combination of the visual rays drawn in these two Figs. 11 and 13, will enable us to give a perfect representation of what the square would appear in its relative position with the other parts described. Fig. 14 is a combination of the two (the relative positions of the parts being similar to Figs. 11 and 13), with the perpendicular lines drawn from the points *j* and *k*: the line drawn from *j*, where it intersects the visual ray *e* E, gives a point *a*,

Fig. 14.



the perspective position of the point *e* of the original object; where it intersects the visual ray *g* E it gives a point *c*, the perspective position of the point *g* in the original object. Where the perpendicular line from *k* intersects the visual ray *f* E, it gives the perspective position *b* of the point *f* of the original; and the point of intersection with the visual ray *h* E gives a point *d* corresponding with *h* in the original object. Thus we have in the points *a b c d* the perspective positions of the four corners of the square A. Consequently, the perpendicular drawn from *j*, where it passes between the visual rays *e* E and *g* E, represents on the plane of delineation the line *e g* of the original object A; that drawn from *k*, where it passes between the visual rays *f* E and *h* E, represents on the plane of delineation the line *f h* of the original object. By ruling lines from the points *a* to *b* and *c* to *d*, we have on the plane of delineation a form such as the object would take on a sheet of glass similarly placed, if the spectator were to trace on it the form he sees through it; the relative positions of the three essentials for perspective drawing being as described,—viz. the positions of the original object, the spectator, and the plane of delineation.

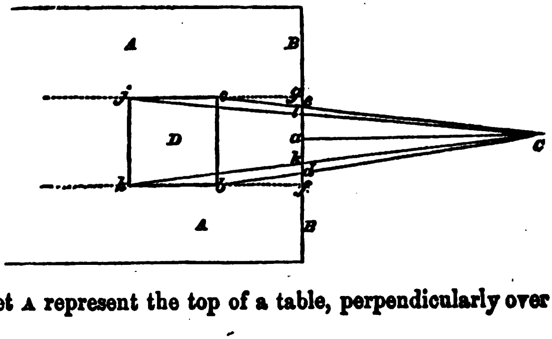
Trusting that the matter in the preceding pages, which may be said to contain the groundwork from which the various modes of representing objects in perspective are deduced, is tolerably understood, we will first offer a few observations, and then proceed to practice. The foregoing may be summed up in very few words: — The rays of light, which are the cause of vision, are understood to proceed from every object in straight lines to the eye of the spectator, and in their transmission are supposed to pass through an imaginary plane, situated somewhere between the spectator and his subject. In order to make a perspective drawing, the points where the rays of light (visual rays) pass through this imaginary plano must be ascertained, these points transferred to the canvas or paper, and by means of these the form and size of the objects accurately delineated. The diagrams requisite have been made with as much attention to simplicity as the subject admitted, and are intended solely to illustrate the principle, that correct representations of form are to be drawn by finding the above-mentioned points: various modes are employed for finding them, which it will be our endeavour to make thoroughly understood.

The horizontal line on the plane of delineation selected for finding the perspective width of the square A (Figs. 11, 13, 14), is the base line, though the same result might be obtained by taking any other horizontal line. The base line is that usually chosen for this purpose; and as it is unquestionably the most convenient, from the circumstance of draftsmen being furnished with a ground plan and elevations from which they are to execute the perspective drawing, it would only be perplexing the student to furnish him with examples and rules for what he may most probably never require. To avoid any errors, it may be well to remark that the ground plane, which is but another name for the surface on which the object to be drawn rests, is supposed always to be a flat even surface of great extent, and that the plane of delineation is always supposed to stand perpendicularly on it. Any deviation from this might materially affect the representation.

CHAPTER III.

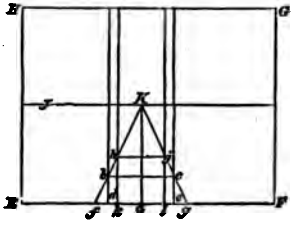
Where a number of objects combined are required to be represented in perspective, to proceed by finding every point by means of intersecting points on the plane of delineation, would be an extremely tedious mode of procedure; and these points are used as sparingly as possible, the main object being to produce accuracy with the smallest possible number of lines. In order to make our illustrations clearly intelligible, and in the comparison of one mode with another, to show that we may arrive at the same result by various means, we are necessarily compelled to employ more lines than would be requisite for an ordinary drawing; but in doing so, we will endeavour to point out the best and readiest modes of proceeding. Vanishing points are what are commonly used for determining the perspective heights of perpendicular lines, as well as for regulating the length and direction of horizontal ones. It has already been explained in Part I. pp. 9, 10, Figs. 14, 15, that those lines in an original object that are parallel, in the perspective representation incline towards each other and meet in a point, which is called the vanishing point: keeping this in mind, let us proceed to draw a plane figure in perspective from the following plan

Fig. 15, Plan.



Let A represent the top of a table, perpendicularly over the edge of which, B, stands a sheet of glass; let C represent the position of the spectator, and D a square figure lying flat on the table. We should here call A the ground plane, the upright sheet of glass over B the plane of delineation, and D the square figure to be represented, the original object viewed from the point C:* from these data it is required to draw the figure D in perspective; the first step towards which will be to draw a parallelogram (Fig. 15, Rep. 1) to represent the picture (E F G H), and across the picture, parallel to the ground line E F, at the height above the ground line the spectator's eye is above the ground plane, draw the horizontal line J (see Part I. pp. 5, 6, Fig. 6).

Fig. 15, Representation 1.



Before proceeding with this drawing, it must be thoroughly understood that the line E F, the ground line in the representation, is in all respects similar to the line B of the plan, and that all points of intersection found on B are to be carried to E F; and moreover, that the parallelogram E F G H is the representation of the plane of delineation standing upon the line B. As in this case we propose to find the perspective positions of the points *b c h j* by means of a vanishing point, the position of this vanishing point must first be ascertained; and the vanishing point in this position of the square relative to the plane of delineation, will be the point of sight, which is always perpendicularly opposite the spectator's eye on the plane of delineation:* we must therefore mark on the base line of the plane of delineation, the point *a* perpendicularly opposite O; carry this point to the ground line E F, and perpendicularly over it on the horizontal line, mark the point of sight at K. In order to find the length the line *b c* will appear, it is necessary to draw the visual rays *b* O and *c* O; carry the points of intersection they make with the base of the plane of delineation *d* and *e* to the ground line E F, and from each draw a perpendicular line on the picture. From *d* to *e* will be the length the line *b c* would appear; the point *b* will be found somewhere on the perpendicular drawn from *d*, and the point *c* on some part of that drawn from *e*.

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* Nothing can be more readily imagined than that the whole of this figure might be drawn from a description of the absolute measurements of the different objects; as, for instance, we might say D to be twelve inches square, situated one foot from B; B four feet long; and C four feet perpendicularly distant from the point *a* on B; the eye of the spectator two feet above the ground plane A. From such a description, a perspective drawing may be made of any size, either large or small, by working from a scale of so much to a foot—either the eighth of an inch, or half a dozen yards.

The lines *b h* and *c j* of the plan are parallel lines; and though if they were continued to any extent they would never meet, yet in the representation they incline towards each other and meet in a point; and being at a right angle with the plane of delineation, this point would be the point of sight. Continue the lines *h b* and *j c* up to the plane of delineation at *f* and *g*, and carry these points to the ground line E F, and from each point draw a line to the point K, the point to which the parallel lines *f b h* and *g c j* of the plan must incline (or any others that might be parallel with them): the intersection of the line *f* K with the perpendicular from *d*, gives the perspective position of the point *b* of the plan; the intersection of the line *g* K with the perpendicular from *e*, gives the perspective position of the point *c* of the plan;

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* The point of sight is always used as the vanishing point for lines that are situated at a right angle with the plane of delineation; those lines that lie in a direction parallel to it have no vanishing point, but are represented by lines parallel to the ground line of the picture. This will be understood when we come to the rule for finding the positions of vanishing points in general; it is necessary here to understand that all lines at a right angle with the plane of delineation do have their vanishing point in the point of sight, and that this point is on the plane of delineation perpendicularly opposite the spectator's eye (Part I. Plate I. A, Fig. 2).

and a straight line drawn from one to the other, the representation of the line *b c*.

The direction of the sides *b h* and *c j* are represented by the lines *b* K and *c* K; and to determine their length, it is necessary to find the positions on them of the points *h* and *j*; which is extremely simple. From the points *h* and *j*, draw the visual rays *h* C and *j* C; carry the points of intersection *k l* on B to the ground line E F, and from each point draw a perpendicular line: where that drawn from *k* intersects the line *f* K is the perspective position of the point *h*; and where that drawn from the point *l* intersects the line *g* K is the perspective position of the point *j*. A line drawn from *h* to *j* completes the drawing, the figure *b c j h* being the perspective representation of the square D, viewed in the positions described.

In the foregoing example more lines have been used than are absolutely required for drawing this figure, but they have been introduced for the more clearly exemplifying the mode for finding the positions of points, by means of a vanishing point and the visual rays; but the visual rays *j* C and *c* C (in the plan) might have been omitted, and consequently the points and lines derived from them on the picture; for, as is shown in the Second Representation, Fig. 15, having the lines *f* K and *g* K drawn, and the points *b* and *h* found by means of the intersections *d* and *k* of the visual rays *b* C and *h* C, the points *c* and *j* are found from the points *b* and *h*. The lines *b c* and *h i* in the plan, being parallel to the base of the plane of delineation, are represented in the drawing by lines parallel to the ground line; hence lines drawn parallel to the ground line from the points *b* and *h* to the line *j* K, give an equally accurate representation of the

Fig. 15, Representation 2.

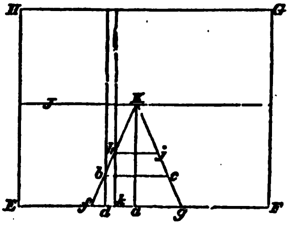
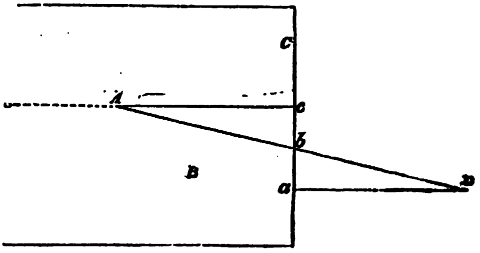


figure in a more simple manner, and at a considerable saving of labour.

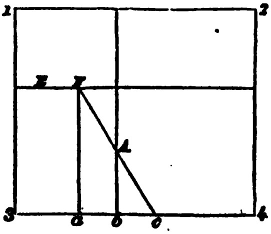
In geometry, a point is defined to be that which has position but not magnitude, and a line to be length without breadth or thickness; the extremities of lines are points, and the intersections of one line with another are also called points. Any straight line may be represented in perspective by finding the positions of its extremities, and any combination of straight lines by finding the positions of the extremities of each separate line. Curves may be drawn in perspective by finding intersecting points in the original figure (Part I. pp. 35, 36), and finding the positions of these points on the plane of delineation. If then a draftsman has the knowledge how to find any single given point, he will be able by the same means to find a second, third, or any quantity; hence, straight lines may be drawn in perspective by finding the position of their extremities, and curve lines by finding points of intersection, by understanding clearly how any single point is to be found. We will therefore proceed to show, first, how the perspective position of any single point is to be ascertained; and afterwards, a combination of them: so that any plane figure may be put in perspective, upon the same principle employed for drawing the square, Fig. 15; as in the above-given plan, Fig. 16, from which it is required to find on the picture

Fig. 16, Plan.



the position of the point A, situated on B the ground plane, the relative positions of the plane of delineation and the spectator being as C and D, the eye of the spectator situated above the ground plane, the height shown by the horizontal line E (Fig. 16, Rep.). First, find the position of the point of sight (as in Fig. 15), by drawing the line *a* D perpendicular to C; draw the visual ray A D, intersecting the base of the plane of delineation at *b*; bring the point A perpendicularly forward to the plane of delineation at *c*,* and then carry these three points *a b c* to the ground line of the picture. From *a* draw a line perpendicular to the ground line, to the horizontal line at F; this will be the point of sight; also a perpendicular line across the picture from *b*, on some part of which the point A will be found. The line *c* A of the plan, being at a right angle with the plane of delineation, will be represented by a line drawn to the point of sight, the vanishing point for all lines lying in that direction; draw therefore the line *c* F, and where this intersects the perpendicular drawn from *b*, will be the position in the picture of the point A required, the line *c* A being the correct perspective length and direction in the representation, Fig. 16, of the line *c* A of the plan.

Fig. 16, Representation.



Simple as the above diagram appears, it is important that it be most clearly understood. In making a perspective drawing consisting of a great variety of objects, the intricacy of lines may at the outset perplex the student, which will pass away with practice; but with a thorough comprehension of the principle on which the foregoing diagrams (Figs. 16) are drawn, he can never be at a loss to find the position of any given point in a picture, whether situated on the ground plane or above it,—as we shall presently show. By this mode any plane figure, however complicated, may be represented in perspective by actual measurement of the original objects: for instance, suppose A, Fig. 16, to be the spot on which any object stands (a man, a tree, or a post, is immaterial for our present purpose), distant perpendicularly from the plane of delineation four feet, the spectator being four feet in front of this plane, his eye situated three feet above the ground plane; from these premises the position of this point may be ascertained with the greatest ease on a sheet of paper or other plane surface, and of any size required, in the following manner:—First, draw a horizontal line, on which mark a series of equal divisions, to serve as a scale to work from, similar to the diagram (Fig. 17) here given,*

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* The drawing a straight line from the point required to be found in the picture up to the plane of delineation, is called *bringing the point up to the plane of delineation*, and the position of it in the picture may be found by bringing it forward in any direction; but in this instance it must be brought forward perpendicularly, otherwise we could not find the position of the point A by means of the point of sight, that being the vanishing point only for lines at a right angle with the plane of delineation. This will be fully explained in the ensuing chapter.

Fig. 17.

which represents a scale of ten feet in length; then draw a line C, equal in length to that of your picture (Fig. 16, Rop. 1), to represent the base line of your plane of delineation; and behind it, at the (perpendicular) distance of four feet,† mark the position of the spot on which the object stands at A, to the right hand of the spectator, then on the picture, three feet of the scale above the ground line, draw the horizontal line, and from these find the position of the point as described, Fig. 16, Representation.

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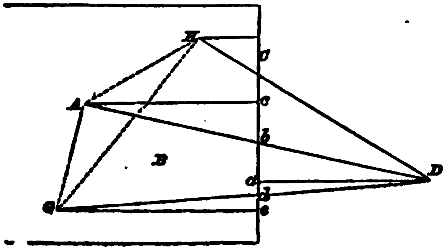
* All geometrical drawings furnished to artists are worked on a scale of so much to a foot, yard, &c. according to the size required. Having the dimensions of the various parts to be represented, measurements are taken from the scale and applied to the drawing, by which the relative proportion of the parts is preserved, however minute the representation.

† The plan, Fig. 16, is worked to the scale here given, for the advantage of the student; but in making his own drawing, it will be better to construct a much larger scale to work from.

Referring back to the diagrams, Figs. 16, at the risk of being accused of prolixity, we will once again go over the several parts; and we will first observe that the space between the ground line 3—4 and the horizontal line E represents a very great extent of flat surface, the whole extent of space between the situation of the plane of delineation to the greatest distance our vision extends; that the point F is the point of sight, that point perpendicularly opposite the eye of the spectator, and the vanishing point for all lines at a right angle with the plane of delineation; the perpendicular line over *b* shows that on some part of that line the point A will come, and the line *c* F determines at what point.

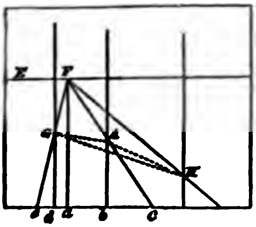
We will now, by the same means employed for finding the position of the point A, find the position of another point on the same plane, B; and that we may not interfere with the simplicity of Figs. 16, we will take a fresh diagram (Fig. 18), premising that the references marked A, B, C, D, E, and F, and *a*, *b*, *c*, are precisely similar to those in Fig. 16.

Fig. 18, Plan.



Let us place another point on the plane B, as at G, the position of which is to be found in the picture by the same process as we found the position of the point A, *viz.* a visual

Fig. 18, Representation.

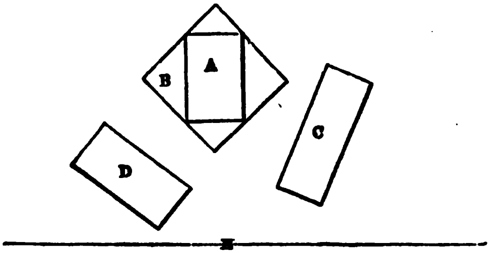


ray G D, must be drawn, and the point of intersection, *d*, carried to the ground line of the picture at *d* (Fig. 18, Representation), and a perpendicular line drawn from it; then bring the point G perpendicularly to the plane of delineation at *e*, carry this point to the ground line of the picture at *e*, and from it draw a line to the point F; the intersection, G, of this line with the perpendicular drawn from *d* will be the perspective position of the point G of the Plan. If we suppose these two points A and G to be the extremities of a straight line, as shown by the dotted line A G in the Plan, then the dotted line A G in the Representation would be the perspective appearance of it. It must then be evident that as by this means we can ascertain the perspective direction and length of one straight line, the direction and length of any other may be found in the same manner, and consequently, any plane figure of straight lines may be drawn in perspective by means of the point of sight only as a vanishing point; thus, if we place another point at H on the Plan, and draw the (dotted) lines H G, G A, and A H, we have the plan of a triangle; and by finding the position of H in the picture in the same manner as the points A and G were found (shown in the diagrams), by drawing the lines G A, A H, and G H, as is done by dotted lines in the Representation, it presents the appearance the triangle would assume viewed as described. Although the mode described in Figs. 16 and 18 for finding the perspective form of any plane figure would produce a correct representation were it ever so complicated, it would be found but a round-about method of proceeding where the figure contains a quantity of lines. The usual and most convenient manner of finding the perspective directions of lines that are at an angle with the plane of delineation is by means of their respective vanishing points; and we will therefore proceed in the next chapter to point out the manner of finding the vanishing points for straight lines at whatever angle they may lie with the plane of delineation, and however numerous the variety of their directions.

CHAPTER IV.

We have already more than once stated that all lines that in the original object are parallel, in their perspective representations incline towards each other and meet in the same point, somewhere on the horizontal line (see Part I. pp. 9, 10, Figs. 14, 15; pp. 11, 12, Plate 1, Fig. 2). It must be further understood, that in drawing a variety of objects, every change of angle a line makes in its inclination towards the plane of delineation requires a fresh vanishing point. Thus in the diagram (Fig. 19) the rectangular figures A, B, C, and D represent the plans of four objects standing on the ground plane F, the situation of the plane of delineation being at E; so situated, each figure would require two distinct vanishing points, the sides of each figure lying at different angles with the plane of delineation. The same would be the case in representing any polygon in perspective; the sides of the

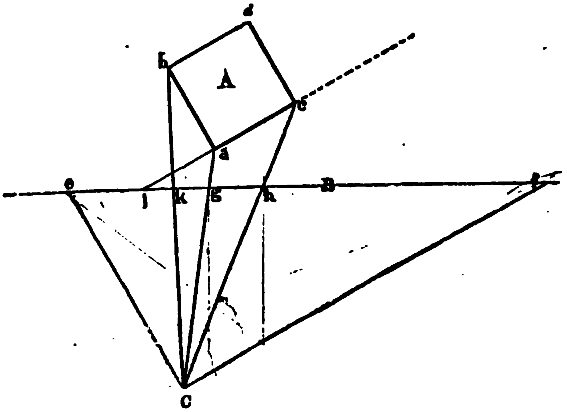
Fig. 19.



polygon being at different angles with the plane of delineation, would require distinct vanishing points.

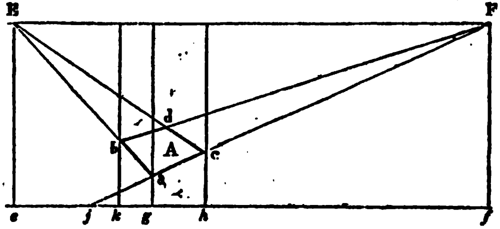
In order to find the vanishing points requisite for putting any object or combination of objects in perspective, it is indispensable to have the plan of them, the position of the plane of delineation (its base line drawn), and the position of the spectator. Whatever may be the direction of any line on the plan for which a vanishing point is required, it is found by ruling a line (parallel to the line on the plan) from the point marking the position of the spectator, and continuing the same till it intersects the plane of delineation; the point perpendicularly over this on the horizontal line will be the vanishing point not only for the line selected on the plan, but for every line parallel to it. Thus in Fig. 20, let A be the position of a square, B the plane of delineation, and C the position of the spectator. The lines *a b* and *c d* being parallel lines in the geometrical plan, in the perspective representation must tend to the same point; to find this point, the edge of a parallel rule must be placed against either *a b* or *c d*, and brought down over C, from which

Fig. 20, Plan.



point a line must be ruled till it intersect the line B,* as at *e*. The lines *a e* and *b d* are also parallel, but at a different angle with the plane of delineation to *a b* and *c d*, and will require a fresh vanishing point, which is found in the same manner; that is to say, from the position of the spectator, C, a line parallel to *a c*, or (what is the same thing) *b d*, must be drawn to the plane of delineation at *f*, and the point perpendicularly over this, on the horizontal line will be the vanishing point for the lines *a c* and *b d*, and for all lines in the plan parallel to them. Let us now carry these points from the plane of delineation to the ground line of the picture, as in the previous examples, and proceed to put the square figure in perspective, first drawing the horizontal line D in the Representation (the height of which depends on the height of the spectator's eye above the ground plane), and placing the vanishing points E and F on it respectively perpendicular

Fig. 20, Representation.



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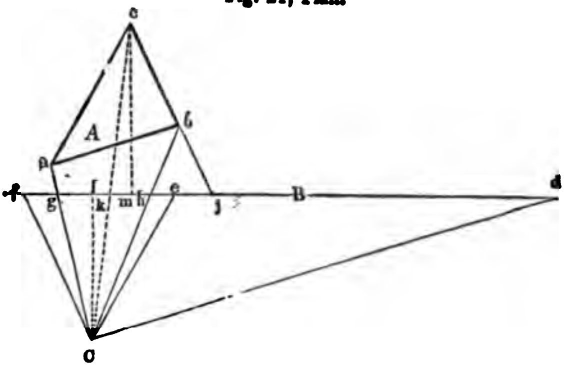
* The plane of delineation being an imaginary plane, may be supposed to extend to any distance. The visual rays must come within that portion of it where the picture is supposed to be, and, as we have shown, the whole might be accomplished by using the point of sight; in such case, no more than that space would be required: but it rarely happens when more than one vanishing point is required that they fall within the picture. Where objects stand in a direction nearly parallel with the plane of delineation, the vanishing points are at a great distance. It is therefore necessary, in finding the positions of the vanishing points, to extend the line representing the plane of delineation some distance both to the right and to the left, and the same will be required with the horizontal line in order to mark the vanishing points on it.

over the points *e* and *f*. On the plan, draw the visual rays *a* C and *c* C, carry their points of intersection, *g*, *h*, on the plane of delineation to the ground line of the picture, and draw perpendicular lines from each. As in the preceding examples, the point *a* will come somewhere on the perpendicular drawn from *g*, and the point *c* somewhere on that drawn from *h*. Now in order to find the position of *a* on the perpendicular drawn from *g*, let us refer back to the square we put in perspective in a different position (Figs. 15, Plan and Representation), and we shall there find that in order to get the position of the point *b*, corresponding with *a* of our present figure, we first drew the visual ray *b* C, carried the point of intersection *d* to the ground line of the picture, and, as in the present case, drew a perpendicular line from it; then in order to find the point of intersection on it, the point *b* was brought perpendicularly to the plane of delineation at *f*, *f* carried to the ground line of the picture, and a line ruled from it to the point of sight E, which gave the point of intersection *b*. In the present figure (20), the points *a*, *b*, *c*, *d* are found in the same way as the corresponding points *b*, *h*, *c*, *j* (Fig. 15); only as the vanishing point for the line *a c* in this case is not the *point of sight*, but the point F, instead of bringing *a* to the plane of delineation by a perpendicular line, it must be brought forward in the direction *c a*, as at *j*, and *j* carried to the ground line of the picture; if a line be ruled from this to the vanishing point F, we have the perspective position of the point *a* on the perpendicular over *g*, and the perspective position of the point *c* on the perpendicular over *h*; the line *j a* of the Representation being the perspective length and direction of the line *j a* of the Plan, the line *a c* the perspective representation of the line *a c* of the Plan, and the portion *c* F of the line *j a c* F, the continuation of the line *j a c* in the direction of the dotted line in the Plan, as far as it is possible for it to be seen. The positions of the points *b* and *d* might be found in the same way as that employed for finding the positions of the points *a* and *c*, i. e. by drawing visual rays from *b* to C, and from *d* to C, carrying their points of intersection to the plane of delineation, and drawing perpendiculars from them, then bringing the point *b* to the plane of delineation in the direction *d b*, and carrying the point of contact to the ground line of the Representation. If from this point a line were drawn to the vanishing point F, its intersections with the perpendicular lines found by the visual rays *b* C and *d* C would fix the perspective positions of the points *b* and *d*, as the intersections of the line *j* F fixed the points *a*, *c* on the perpendiculars over *g* and *h*. This manner of proceeding, however, though perfectly accurate, is not the *readiest* way to determine the positions of these points; it is quite sufficient to draw the visual ray *b* C, and carry the point of intersection, *k*, to the ground line of the representation, and draw a perpendicular from it, on some part of which the point *b* will come. The position of the point *a* is already ascertained, and the vanishing point for the line *a b*; therefore, if a line is drawn from *a* to the vanishing point E, the point of intersection with it and the perpendicular drawn from *k*, is the position of the point *b*. F being the vanishing point for the line *b d* (this line being parallel to *a c*), from *b* draw the line *b* F; E being the vanishing point for the line *c d* (*c d* being parallel to *a b*), from *c* draw the line *c* E; the point of intersection of the two lines *b* F and *c* E is the perspective position of the point *d* of the Plan, and completes the perspective drawing of the square A of the Plan by means of the vanishing points.

Having shown by the diagrams of Figs. 16 and 18 how a triangle (or any other rectilinear figure) may be drawn in perspective by finding the positions of the points at the extremities of the lines, using the visual rays and point of sight only as a vanishing point, we will now take a similar figure, and point out the manner of drawing a perspective representation of it by means of the respective vanishing points for each line of the triangle, and comparing the former mode, that of Fig. 18, with the one we are about to describe, show that the result is the same.

Fig. 21, Plan.



Let A in the plan, Fig. 21, represent the triangle, B the plane of delineation, and O the position of the spectator. Find the respective vanishing points on the Representation (after drawing the horizontal line) for the lines *a b*, *a c*, and *b c*, the sides of the triangle A at D, E, and F;* draw the visual rays *a* O and *b* O, and carry the points of intersection *g*, *h* to the ground line of the picture, from each of which draw a perpendicular line; bring the point *b*, in the direction *c b*, to the plane of delineation at *j*, carry *j* to the ground line of the picture, and to the vanishing point for the line *b c* (F) draw the line *j* F; the intersection of this with the perpendicular from *h* is the perspective position of the point *b*. From the vanishing point D (the vanishing point for the line *a b*), through the point *b*, draw a line till it meet the perpendicular drawn from *g*, this will give the position of the point *a*;* from *a* draw the line *a* E, the intersection of which with the line *b* F gives the perspective position of the point *c*, which completes the figure of the triangle, *a b c*, in perspective, and by a mode much more simple than that described in Fig. 18.

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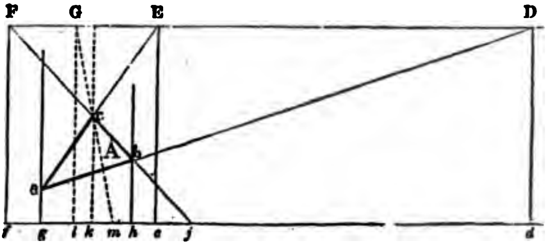
* This being a different figure to the last, and knowing from experience as a teacher how trifling a variation will sometimes confuse beginners in these matters, we repeat for their assistance the proceedings of the last figure; from O, the position of the spectator, parallel to *b c*, draw the line O *f*; the point on the horizontal line perpendicularly over *f* will be the vanishing point for the line *b c*, or any lines that may be parallel to it. From O, parallel to *a b*, draw the line O *d*; the point D on the horizontal line perpendicularly over *d*, will be the vanishing point for the line *a b* and all lines parallel to it. From O, parallel to *a c*, draw the line O *e*; the point E on the horizontal line perpendicularly over the point *e* will be the vanishing point for the line *a c* and all lines parallel to it. If a figure consist of twenty or more sides, each side in a different angle, their respective vanishing points may be found in the same manner.

To prove, however, that the result would be the same whichever mode of proceeding were adopted, we have drawn the visual ray *c* O by a dotted line, and carried the point of intersection, *k*, to the ground line of the picture, from which we have also drawn a perpendicular (dotted) line. We have also by a perpendicular from O to the plane of delineation (O *l*) determined the position of the point of sight, which we have placed perpendicularly over *l* on the horizontal line at G; the point *c* we have brought perpendicularly to the plane of delineation at *m*; we have placed *m* on the ground line of the Representation, and from it drawn a line to the point of sight, G. It will be seen that the intersection of this line with the perpendicular drawn from *k* is in the same point (*c*) as that where the lines *a* D and *b* F intersect each other,

Fig. 21, Representation.



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* This is a much readier way of finding the position of *a* than if we had brought, as was done, with the point *b*, the point *a* of the Plan, in the direction *b a*, to the plane of delineation, carrying that point to the ground

proving that the same result may be arrived at by different means.

After perusing the descriptions given, and examining the diagrams illustrating them, for finding the positions of vanishing points, a little attention ought to make the student comprehend why it is that the lines of original objects that are situated at a right angle with the plane of delineation have their vanishing point in the point of sight, and that those lines which in an original object are parallel to the plane of delineation have no vanishing point, but are drawn parallel to it, or rather to the ground line of the picture. This will be fully understood by comparing the plans of Figs. 20 and 21 with that of Fig. 15; for if we require to find the vanishing point for the sides *b h*, *c j* of the square D, Fig. 15, both of which are at a right angle with the plane of delineation, it is clear that a line drawn from C, the position of the spectator parallel to them, to the plane of delineation at *a*, must be perpendicular to it, which is always the position of the point of sight. Again, according to this rule for finding the vanishing points of lines from a plan, if we endeavour to find one to which the sides *b c* and *h j* should be drawn, a line through the point C parallel to them must also be parallel to the plane of delineation, and consequently could never meet; hence it is that all lines that in original objects are parallel to the plane of delineation, are drawn parallel in the perspective representations. This manner of representing objects is frequently called Parallel Perspective, and that where all the sides of an object are at an angle with the plane of delineation, Oblique Perspective.

The object of this work not professing more than to make the student thoroughly comprehend the system on which he is to proceed in making perspective drawings,

line of the picture, and from it ruling a line to the vanishing point D. The result is obviously the same, as it can make no difference whether the line *a b* D is commenced from one point or the other, the direction must be the same.

the examples already given are sufficient, it is hoped, to enable him to draw any plane rectilinear figure in perspective that may be put before him. No example has been given for drawing curves, but as we have in Part I. pp. 35, 36, already stated that in order to draw curves in perspective, rectilinear figures must first be made, to get intersecting points through which the curves are to be drawn, the examples already given are considered ample for the present. Nevertheless, before proceeding farther, the student, if so disposed, will find it to his advantage to take the plan of the circle (Part I. Prob. V. Plate VI.) with the right lines about it, and marking a point for the position of a spectator and a line for that of the plane of delineation, draw it in perspective, as also Figs. 4 and 6, Part I. Plate XIII.

CHAPTER V.

We have hitherto confined our examples entirely to the representations of plane figures, without taking into consideration at all the height or thickness of objects. We will now proceed to show how solid figures are to be drawn in perspective upon the principles we have already laid down. In order to be able to give a correct representation of any solid figure in perspective, it is not only requisite that we should have the form of the base of the object on a plan with its relative position with the plane of delineation and position of the spectator, but we also require, either by drawing or description, the form and dimensions of its different parts. If the solid to be represented be simply a cube, it is unnecessary to have more than the plan furnished, as, one face of a cube being given, the remaining five are known to be similar. It must be understood, that in drawing plans from which perspective drawings are to be executed, a mere ground plan will not be found adequate to the purpose, for as the base line only of the plane of delineation is used for finding the perspective positions of the different parts of a structure, projections, recesses, &c., though they may occur twenty or thirty feet above the base of a building, must be first drawn on the geometrical plan, their perspective positions found, and then carried up to the height required; in fact, the plan of a building required for making a perspective drawing must consist not only of the ground plan, but of a series of horizontal sections to the very top, wherever any change of form occurs. This will be better understood as we proceed, and when we have occasion for such a plan, we will recur to the foregoing remarks.

The cube being the most simple form of solid to put into perspective, we will select that as our first example. In Fig. 15, pp. 90, 91, 93, we have drawn in perspective the plan of a cube as seen in a certain position—in what is termed parallel perspective. In referring to this figure (in which it will be remembered that the sides *b h* and *c j*, from their being at a right angle with the plane of delineation, have their vanishing point in the point of sight), the points *b* and *c* are said to be brought to the plane of delineation at *f* and *g*, which makes the distance between *f* and *g* exactly the same as that between *b c* and *h j*. To make this perfectly clear, let us suppose the dotted lines *g c j* and *f b h* to be grooves, on which the face of a cube perpendicularly over *b c* could be slid backwards and forwards; if we were by means of these grooves to slide the square forward, we should *positively* bring the points *b* and *c* up to the plane of delineation. The pupil can therefore have no difficulty in understanding that in Fig. 15, *f g* on the ground line is the width of the square right up to the plane of delineation, and that the line *b c* in the Representation is the width the same line would appear at the distance of *f b* of the Plan from the plane of delineation. Now let us imagine the square D (Fig. 15) to be a base on which a cube stands, and that this cube could be slid forward on the grooves, up to the plane of delineation. We should then have the front face of a square absolutely on the plane of delineation; we should have a perpendicular line over *f* the length of *b c*, one of equal length over *g*, and a line parallel to *f g* passing from the top of one to the top of the other; in fact, the form of the square on the plane of delineation (see Fig. 22, Rep.). It is unnecessary in constructing this cube to go over the ground a second time for finding the position of the square D on the picture, as in Fig. 15, the plan of which we have given again in Fig. 22. The square in this plan is placed distant from the plane of delineation exactly its own width, and for the advantage of showing the lines more distinctly, the position of the spectator a little to the left. Those points on the plane of delineation only are introduced that

Fig. 22, Plan.

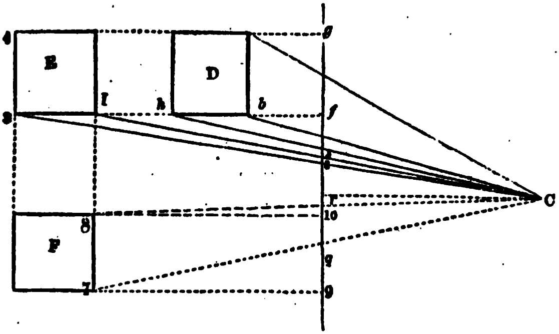
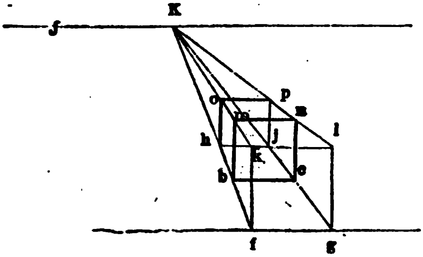


Fig. 22, Representation 1.



are requisite for drawing the square in perspective, as described for Fig. 15, Representation 2; and in the diagram of the Representation, Fig. 22, all lines are erased but those necessary for our present purpose. In case the student may have forgotten any portion of the directions for drawing Fig. 15, Representation 2, he can refer back to p. 93 to refresh his memory.

We have above stated, that in order to find the points for constructing a cube in perspective standing over the square *b c j h*, we must suppose the face of it opposite to the spectator, to be brought forward to the plane of delineation, and according to that description, we must construct a square on the line *f g*, as *f g k l*, which is really the geometrical elevation of the cube of its full size. It is very evident that the perspective position of the point *k* must come somewhere on a perpendicular line over the point *b*, and the perspective position of the point *l* somewhere on a perpendicular line drawn from *c*; draw then from each of these points, *b* and *c*, an indefinite perpendicular line, and from each of the points *k* and *l* draw a line to the vanishing point (the point of sight) K; where the line *k* K intersects the perpendicular drawn from *b* at *m*, it gives the perspective position of the point *k*; where the line *l* K intersects the perpendicular drawn from *c* at *n*, it gives the perspective position of the point *l*; by joining the points *m* and *n*, we have in the figure *b c n m* the appearance of the figure *f g l k* at the distance of *f b* from the plane of delineation shown in the Plan, and the plane *b c m n*,* being parallel to the plane of delineation, does not change its form, but only decreases in magnitude according to its distance. The angles of the cube standing over the points *h* and *j* of the Plan, must now be drawn perpendicularly from the points *h* and *j* of the Representation, that from *h* up to the line *k* K at *o*, and that from *j* up to the line *l* K at *p*; by joining the points *o* and *p*, *h j p o* will be the representation of the square plane at the back of the cube; this also being in a plane parallel with the two former, still preserves its geometrical form, though smaller from its increased distance. Thus, *b c n m* being the position and form of the front of the cube, and *h j p o* of the back, *m n p o* must be the appearance of the top, and *b m o h* of the side that is visible, it being unnecessary to point out that the sides of the top and the side of the bottom that is seen, must have been drawn in determining the positions of the points *h*, *o*, and *p*. If another cube stood over the square in the Plan *f g c b*, the square *f g l k* would represent the front, *b c n m* the back,* and consequently *l n m k* the top, and *f k m b* the side visible to the spectator.

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* The student must here understand, that as we speak of the *lines* in the plane figure of the square in the Plan being parallel to or at an angle with another line, so do we speak of the planes in a solid figure; thus the square surface perpendicularly over the line *b c* we call a plane parallel to the plane of delineation, as we also call the perpendicular surface over the line *h j*, the surfaces of the back and front of a cube necessarily being parallel. In speaking of the sides of the cube perpendicularly over the lines *b h* and *c j*, we say that the planes of the sides are at right angles with the plane of delineation. The top and bottom of the cube are

In this figure, as in Fig. 15, Representation 2, in order that the principle on which the different planes of the cube are drawn should be well understood, more lines are introduced than are absolutely required to represent the figure it assumes; a more simple manner of drawing the Representation would be as shown in Fig. 22, Representation 2. Having drawn (as described, Fig. 15) the square *b c j h* in perspective, draw from each of the points, *b*, *c*, and *h*, an indefinite perpendicular line; from the point *g*, set up the perpendicular height of the cube at *l*, and from *l* draw the

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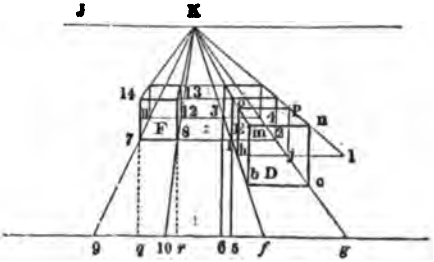
also in planes at right angles with the plane of delineation, but they are in horizontal planes, and the sides in perpendicular planes. It is as easy, after a little practice, to comprehend the term "plane," as the word "surface."

* In order to find the positions of certain points, it is frequently necessary to draw parts that cannot by possibility be seen, and in order to make this figure perfectly intelligible, several lines are drawn as if the cube were transparent.

line *l* K; where *l* K intersects the perpendicular from *c*, it gives the point *n* of the preceding figure. The top of the cube being parallel with the bottom, *n m* must be parallel to *c b;* draw then from *n* a line parallel to *c b*, and where this intersects the perpendicular from *b*, it gives the point *m;* from *m* draw the line *m* K; the intersection of this with the perpendicular from *h* gives the point *o; o p* being parallel to *m n*, draw from *o*, parallel to *m n*, a line to meet the line *l* K, which gives the point *p:* the intersection of these two lines obviates the necessity for drawing a perpendicular from *j*.

Fig. 22, Representation 2.



Suppose another cube to stand upon the square E, and it is required to put this cube also in perspective behind the cube D. To do this, we must draw the visual rays 1 C and 3 C, and carry the points of intersection 5 and 6 to the ground line of the Representation, and from each point draw a perpendicular line between *f* K and *m* K; from the points of intersection on *f* K draw horizontal lines to meet the line *g* K; from the points of contact on *g* K draw perpendicular lines to meet the line *l* K; from the points of contact on *l* K draw horizontal lines to *m* K; the points of contact with the line *m* K will be the same as with those from the perpendiculars drawn from the points 5 and 6, and will complete the perspective drawing of a cube standing over the square E of the Plan.

Let us place a third square (F) on the plan, over which we will suppose another cube to stand, and we shall perceive with how much facility this third cube may be drawn in perspective. Bring the points 7 and 8 to the plane of delineation at 9 and 10 (in the same way as the points *b c* of the square D were brought to *f*, *g*); bring these points to the ground line, and from each of them draw a line to the vanishing point K. The square F being (as is seen in the Plan) at the same distance from the plane of delineation as the square E, all the points for drawing the square F and the cube standing on it may be found from the cube E already drawn, as follows: continue the horizontal lines 2—1 and 4—3 till they intersect the lines 10 K and 9 K; from the points of intersection 7 and 8, 11 and 12, draw up indefinite perpendicular lines; continue the horizontal line of the top of the front face of the cube E to intersect the perpendiculars from 7 and 8 at the points 13 and 14, and from each of these draw a line to the vanishing point K. If a line be now ruled from the points where the lines 13 K and 14 K intersect the perpendiculars drawn from 11 and 12, it will complete the perspective drawing of the cube standing over the square F of the Plan, and show that having by means of the visual rays fixed the positions of certain points in one object, the positions of the points required for drawing another object may be found from the first without the necessity of additional visual rays, and the result will be the same with less labour. To illustrate this, we have introduced the visual rays 8 C and 7 C, and placed the points of intersection *q*, *r* on the ground line; it will be seen by the perpendicular (dotted) lines drawn from these points, that they pass directly through the points 7 and 8, found by a different mode.

The principle on which a solid is drawn in perspective, where all the planes are at an angle with the plane of delineation, is as simple as the one just given, Fig. 22, where some of the planes are parallel to it. In the example given, p. 100, Fig. 20, we have put in perspective a square having all its sides at an angle with the plane of delineation. Let us refer to these diagrams, Figs. 20, supposing a cube to stand over the square A, and proceed to draw a perspective representation of it, according to the Plan.* In this representation, the square A is put in perspective in the manner described for the Representation, Fig. 20, and the

Fig. 23, Plan.

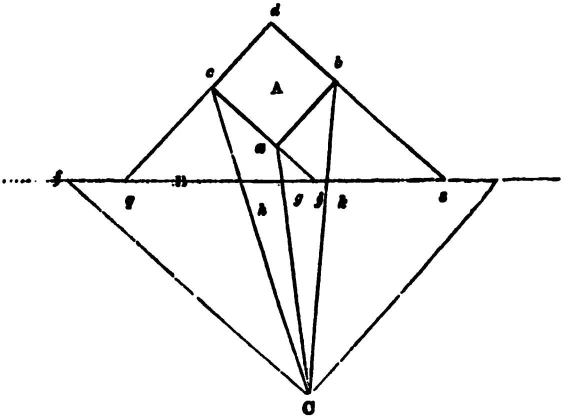
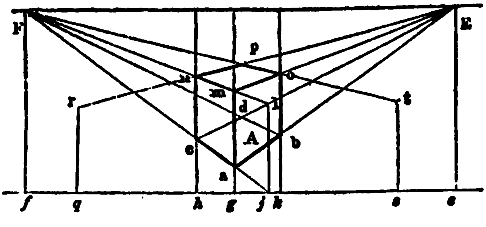


Fig. 23, Representation.



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* The same plan we have given, Fig. 20, would fully answer the purpose for constructing a cube on the square A, but a new one is considered requisite, in order to introduce some additional lines, which would have caused considerable confusion if put into the former one; the principle for drawing it is the same, although the figure is reversed.

point *a* is brought to the plane of delineation at *j*, as the point *c* of Fig. 22 was brought to the plane of delineation at *g*, only that as the side *c j* is at a right angle with the plane of delineation, the point *c* is brought (following the direction of *j c*) perpendicularly to it; whereas the line *a c* of Fig. 23, not being at a right angle with the plane of delineation, the point *a* is brought to it in the direction of *c a*. From this point *j*, set up the perpendicular height or the cube (the length of any side of the square A of the Plan) at *l*; this point will determine the height of the four angles of the perspective square over the points *a*, *b*, *c*, *d*; we have already got the perpendiculars from *a*, *b*, and *c*, in the lines drawn from *g*, *k*, and *h*, and may therefore proceed at once to determine the height of them. From *l* draw a line to the vanishing point F, which will determine the height of the perpendicular lines over *a* and *c* at *m* and *n*, as the line *l* K (Fig. 22, Representation 2) determined the positions of the points *n* and *p*. The point *m*, in Fig. 22, Representation 2, was found by drawing a line parallel to the ground line from *n* to intersect the line drawn up from *b*, on account of the plane *c n m b* being parallel to the plane of delineation; but the plane standing over the line *a b*, Fig. 23, being at an angle with the plane of delineation, all the horizontal lines on that plane must be drawn to the same vanishing point; therefore from the point *m*, a line must be drawn to the vanishing point E, the intersection of which with the perpendicular from *b*, determines the height of it at *o*: if a line be now drawn from *o* to the vanishing point F, and from *n* to the vanishing point E, the point of intersection *p* of the two lines will be found perpendicularly over *d*, and completes the perspective drawing of a cube standing in the position described in the Plan, Fig. 23.

In order to determine the heights of the different angles of the cube *a m*, *c n*, *d p*, and *b o*, it is immaterial whether the point *a* is brought to the plane of delineation in the direction *c a* to *j*, or whether it is brought forward in the direction *b a;* in fact, either of the three points *a*, *b*, or *c*, would answer equally well to find the heights of these perpendicular lines; for if the point *c* were brought forward to the plane of delineation in the direction of the line *d c*, as at *q* (in the Plan), and this point carried to the ground line of the Representation, a perpendicular drawn from it the geometrical height of the cube, will be found to produce the same result as that produced by the point *l*, as is shown in the Representation. The point *q* is placed on the ground line, and the geometrical height of the cube set over it at *r;* from *r* a line is drawn to the vanishing point E, and it will be seen that the point of intersection with the perpendicular from *c*, is in the same point with that drawn from *l* to the vanishing point F; and the intersection giving the point *p* must necessarily be the same. Again, if the point *b* was brought forward to the plane of delineation in the direction *d b*, as at *s* (Plan), *s* carried to the ground line, and the geometrical height of the cube set over it at *t*, and this point chosen for determining the height of the perpendicular angles, the same result would ensue as in the two preceding cases; the line *t* F intersecting the perpendicular from *b* in the same point as the line *m* E.

If the perspective height of the cube is to be determined from the line *q r* on *c n*, it determines by the same line the height of *d p;* the point *m* would be found by ruling a line from the vanishing point F through *n* to intersect the perpendicular from *a;* the intersection will be found in the same point as found by the line *l* F; the point *o*, in this case, would be found on the perpendicular line from *b*, either by the intersection of a line drawn from the point *m* to the vanishing point E, or of a line drawn from the vanishing point F, passing through the point *p*. It has then been clearly shown that any point may be selected, and that the perspective height of the cube being found at any one angle, the height of the remaining three may be determined from it.

The student, if he has paid attention to the directions given for drawing all the preceding figures, ought now to be able to draw in perspective with tolerable facility a more complicated one than any we have yet used for our illustrations, and that by simple description. By a mere servile copying, in his progress through the work, the diagrams we have introduced, he may be liable to forget some of the earlier ones in his anxiety to get forward, and he is strongly recommended, as he proceeds, not only to draw with care and more than once each separate figure as it occurs, but to vary the positions of the objects or the spectator in his plans, and then put them in perspective. To draw an octagonal tower from a plan in perspective, is not more difficult than to represent the cubes in Figs. 22 and 23, it only requires a greater number of lines; but by a careful attention to the rules we have already given, a tower of any number of sides may be drawn without the necessity for any extra directions, as it ought to be quite superfluous to inform the student, that if the horizontal lines that in the perspective representation tend to any vanishing point are situated *above* the spectator's eye, they incline downwards instead of upwards. In order, therefore, that the student may satisfy himself that he has fully comprehended the foregoing rules, we will furnish him with the plan of an octagon tower, with the relative situations of the spectator and the plane of delineation, of which he must draw the perspective representation from description. We have, therefore, in the diagram (Fig. 24) given the plan of the tower, A, the position of the spectator at C, his eye situated five feet above the ground plane, and the plane of delineation at B, marking each angle of the tower at 1, 2, 3, 4, 5, 6, 7, 8. According to the position in which the spectator is placed in looking at an octagon tower, he may see either three or four of its sides;* in the position in which it is here placed, four of the sides are visible, 8—1, 1—2, 2—3, and 3—4. The width these sides would appear in the picture is determined by the visual rays drawn from the points 8, 1, 2, 3, 4, precisely similar to the manner of finding the width of the sides of the cube, Figs. 22 and 23; the points of intersection, *a*, *b*, *c*, *d*, *e*, on the plane of delineation, must be carried to the ground line of the picture, from each of which a long perpendicular line must be drawn (the top of the tower being considerably above the eye of the spectator). In the position of this figure relative to the plane of delineation, we see that the lines 1—2 and 6—5 are parallel to it, and consequently have no vanishing point; that the lines 3—4 and 8—7 are at right angles with it, and will consequently have their vanishing point in the point of sight; that the parallel lines 1—8 and 4—5, being at an angle, not a right angle, with the plane of delineation, require a distinct vanishing point, as will also, for the same reason, the parallel lines

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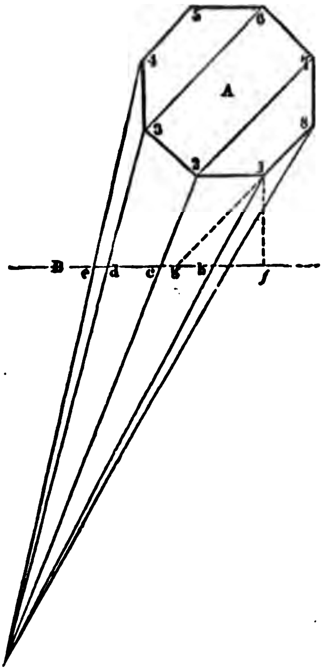
* It is possible to place the spectator opposite either angle of the octagon, so that only two sides would be visible; indeed, if he were close to such a tower, perpendicularly opposite either of the sides, that side only would be seen. But we shall be able to point out in our remarks on the

Fig. 24.



positions to be chosen for making perspective drawings, that those positions where only one or two sides are seen are such as are inadmissible for making perspective drawings.

2—3 and 7—6. The position of these vanishing points then must be found on the plane of delineation, as described in Figs. 20 and 21, carried to the ground line, and perpendicularly over them set on the horizontal line.

Having set these points on the horizontal line, that is, the point of sight, which should be marked D,* the vanishing point for lines parallel to the sides 1—8 and 4—5, which mark E, and the vanishing point for the sides 2—3 and 7—6, which mark F, proceed to draw the figure in perspective. It is immaterial, in determining the positions in the picture of the points 1 and 2, which of them is brought to the plane of delineation, as the position of one being ascertained, the other may be got from it (see the points *c*, *a*, and *b*, Fig. 23). Let us choose the point 1, and we shall find that it is immaterial also whether this point be brought perpendicularly to the plane of delineation at *f*, or in the direction of the side 8—1, at *g*. If the former, *f* would be carried to the ground line, and a line ruled to the point of sight D, the intersection of which with the perpendicular drawn from *b*, would be the perspective position of the point 1; if the latter, *g* would be carried to the ground line, and a line ruled from it to the vanishing point E, which would intersect the perpendicular from *b* in the same point as the line *f* D (Fig. 21). The position of the point 1 being ascertained, the remaining corners may be found from it; as, from 1 draw a line parallel to the ground line, where this intersects the perpendicular from *c* is the point 2; from this point draw a line to the vanishing point F, the point of intersection with the perpendicular from *d* is the position of the point 3; from 3 draw a line to the vanishing point D, the point of intersection with the perpendicular from *e* is the position of the point 4. If *g* be the point chosen from which the position of the point 1 is determined by *g* E, the same line will give the point 8 at its intersection with the perpendicular from *a*; if the point 1 be determined by the line *f* D, then a line mus be drawn from the point 1 to the vanishing point E to determine the point 8. These four lines, 8—1, 1—2, 2—3, and 3—4 of the base of the octagon tower, are all that can be seen from the station C, and we have now to determine the heights of the perpendicular angles over these points 8, 1, 2, 3, 4. The perpendicular lines from these points are already drawn, and the height of one being determined, the heights of the remainder may be ascertained from it. Supposing the height of the tower to be five times the length of from 1 to 2, this height must be set up on a perpendicular line from the point *g* (on the ground line), and marked *h*, from which point a line drawn to the vanishing point E will determine the height of the angles of the tower over 1 at *j* and 8 at *k*; the heights of the three remaining angles standing over 2, 3, and 4, may be determined in the same way that the points 2, 3, and 4 were found; that is, from *j* draw a line, parallel to the ground line, to the perpendicular from *c*; from the point of intersection draw a line to the vanishing point F till it meets the perpendicular from *d*, and from this point of intersection, a line to the point of sight D to meet the perpendicular from *e*, which will complete the drawing of an octagon tower, viewed from the position shown in the plan, Fig. 24.*

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* The student must be careful to mark the references as they are described, as he proceeds; he will by this means get on without difficulty; by neglecting to do so, he will get sadly perplexed.

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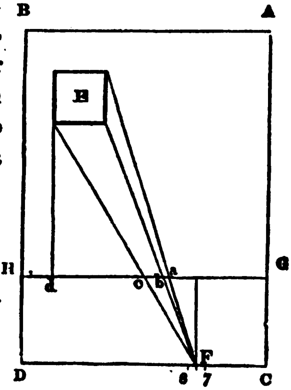
* In giving the description for putting this figure in perspective, we stopped at finding the positions of the points 8 and 4, four sides of the octagon only being seen from the position at C. It may be as well to point out how the whole plan of the octagon might be completed from the points already found, without drawing any additional visual rays. It will be seen that the lines joining the points 2 and 3 with 7 and 6, are parallel with the lines 1—8 and 4—5, and consequently, to represent them in perspective they must be drawn to the same vanishing point E: therefore from 8 draw a line to the point of sight D, and from 2 draw a line to the vanishing point E; the intersection of these lines gives the point 7; from 7 draw a line to the vanishing point F, and from 3 to the vanishing point E; the intersection of the lines gives the point 6;

An experiment practically proving the accuracy of a series of diagrams, not only tends to fix certain principles in the mind of the student, but frequently, if the principles are but imperfectly comprehended, is an inducement to him to retread his ground, in order to render himself capable to become the exhibitor of the same in his turn; and moreover, the satisfaction derived from witnessing the perfection of an experiment gives great encouragement for perseverance in the continuation of his studies. To this end we propose describing a simple but most satisfactory experiment, that will afford a convincing proof of the correctness of the principles on which the preceding figures have been drawn.

Fig. 25.



In the annexed diagram, Fig. 25 (the whole of which is drawn to a scale from the objects described), the parallelogram A B C D represents the top of a common table, upon which over the square E stands a cube;* on the line C D (which represents the edge of the table), take any point as the position of the spectator, which we have here fixed at F, and across the table parallel to the edge C D, draw a line G H, to represent the base of the plane of delineation, over which the plane of delineation is supposed to stand; then from the corners of the object on the table, draw the visual rays; find the

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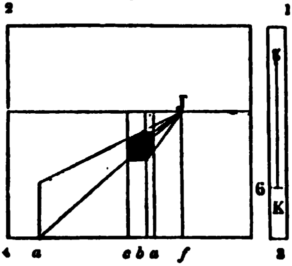
from 4 draw a line to the vanishing point E, and from 6 a line parallel to the ground line to meet it; the point of intersection will give the point 5, and complete the figure of the octagon in perspective. The same result might be arrived at in various ways, but the principle would be the same.

* We are obliged to specify some particular figure, but a work-box, desk, book, or other object, no matter what, may be chosen.

position of the point of sight by a perpendicular from F and bring one of the angles of the square on which the cube stands perpendicularly to the plane of delineation, as described in Figs. 15 and 16. Construct a parallelogram 1, 2, 3, 4, to contain the representation; carry all those points to the ground line, Fig. 26, and then draw the cube in perspective as described in Fig. 22. The representation, to answer the purpose of our experiment, must be drawn on a piece of stiff pasteboard; the height of the horizontal line being placed above the ground line, the same height the eye is situated above the edge of the table C D, and should be sufficiently elevated to enable the top of the object to be distinctly seen. A strip of card must now be cut similar to K, Fig. 26, a straight line 5 6 drawn across it, and from this a perpendicular line must be drawn the length of the space from the ground line to the horizontal line, to *g*, at which point drill a small hole with a pin. Place this strip of card upright on the edge of the table C D, the point 5 at the point 7, and the point 6 at 8, which will bring the point *g* exactly opposite the point of sight.

Fig. 26.



Let the form of the cube (the whole of the tinted figure) in Fig. 26, be carefully cut out, and the piece of pasteboard on which it was drawn set perpendicularly on the table in the place where the plane of delineation is supposed to be situated; the point 3 standing on G, and the point 4 on H, the points *f*, *a*, *b*, *c*, *d* must necessarily come over their corresponding points on G H, and the hole *g* in the card perpendicularly opposite the point of sight J. If in this position of the different parts, the student place his eye close to the hole *g* in the strip of card K, he will find the cube, standing over the square B, to fit exactly to the hole cut out of the pasteboard. In order to be quite successful in this experiment, a perfect adjustment of all the parts is indispensable; the drawing must be made with great accuracy, and the greatest care must be taken that the piece of pasteboard containing the figure of the cube, and the slip of card through which the hole is pierced, stand perfectly perpendicular to the plane of the top of the table.

This experiment may be repeated with advantage in a variety of ways, all of which variations will illustrate some portion of the text in the preceding chapters. It will be found, that the slightest change in the position of any of the parts will destroy the effect: the position of the eye must neither be moved to the right nor left, neither higher nor lower; if the line G H were drawn closer to C D, the hole would be too large for the cube to appear to fit it; if it were drawn farther back, the hole would appear too small; any change in the position of the cube itself would alike destroy the effect.

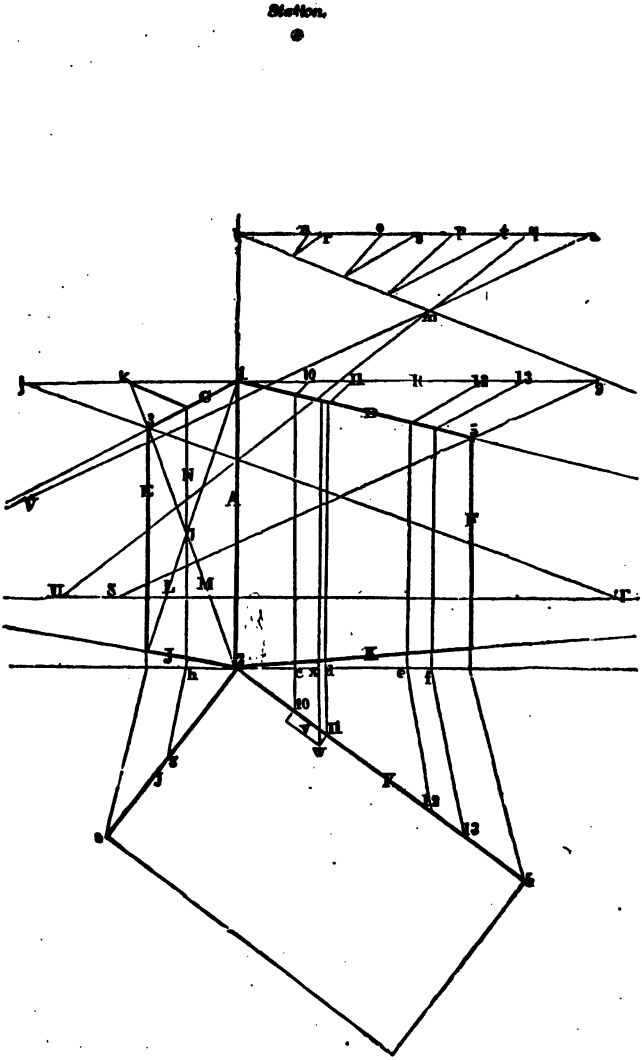
If only one face of the cube were to be drawn, the figure would be similar to D, the representation of A, Fig. 11; in such a figure, whether the square stood parallel to or at an angle with the plane of delineation, if pieces of twine were attached to the four corners of the real square, the four strings first passed through the hole cut in the pasteboard standing over G H, then through the hole *g* in the strip of cardboard, and the strings pulled tight so as to form straight lines from the original square to the point *g*, they would be found to touch the four corners of the hole representing the form of the square in perspective; thus referring to Fig. 11, and supposing A to be the front of the cube, D the hole cut in the pasteboard, and the point E the hole in the strip of cardboard, the strings from the corners of the original square drawn tight to the point *g*, would touch the four corners of the hole cut in the board, as the lines drawn from the corners of the square A to E, touch the corners *a*, *b*, *c*, *d*, of the square D.

For teachers at schools, or for those who receive pupils in classes, a small apparatus for this experiment would be attended with a very trifling expense, and would prove as advantageous to the teacher as to the pupil: to illustrate by experiment being easier to the master than by description, and much less difficult of comprehension to the scholar. Any figure may be selected for this experiment, and the representations of circular figures, to those not conversant with perspective drawings, cause considerable astonishment.

After an attentive examination of the rules contained in the preceding chapters, the student ought to experience no difficulty in finding the situation on the horizontal line of all vanishing points that are requisite for drawing in perspective any plane figure, however complicated; nor do we think he ought to be at fault in constructing a solid figure upon it; it is frequently, however, necessary to have on the same plan a variety of figures, drawn one within the other, representing projecting and receding parts situated over the plan. To represent these in perspective with accuracy, requires great attention and considerable nicety; and as we have given no figure of this kind either in this or the first part of our work, we will introduce a plan and perspective view of one of the buttresses of Magdalene Bridge, Oxford, which affords an excellent example for illustration. Before, however, proceeding to any more complicated representation, we propose to make a few general observations, and compare the processes described for drawing perspective in the First and Second Parts.

In the various diagrams we have already given, it must be quite evident that the same result in finding the perspective positions of points in a picture is to be attained in a variety of ways; and though, in the first instance, in order to determine the position of some *leading* point or points from which others may subsequently be drawn, it is requisite that the relative positions of the plane of delineation, &c., must be fixed, so that the general outline of the subject shall be

Fig. 27.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arranged by the visual rays and vanishing points, much of the detail may be accomplished by more simple means. This is clearly shown in the manner of drawing the perspective cube F, in Fig. 22, Representation 2, the whole of which may be drawn without the necessity for introducing any visual ray at all. The same may be observed by referring to the Representation, Fig. 21, where the point *c* of the triangle is formed by the intersections of the lines *a* D and *b* F, without the necessity of a visual ray, as is also the point *d* in the Representation, Fig. 20.

Those modes for making perspective drawings that are attended with the fewest number of lines are always to be preferred; and it would surprise many who are not accustomed to execute drawings in perspective, to witness the rapid and very simple manner in which intricate drawings are made by those who make it their business. In our endeavours to explain with sufficient clearness the manner of finding the perspective positions of certain points by means of drawing the visual rays through the plane of delineation, we have in every instance made the plan quite distinct from the representation, which is really the fact, as it must never be lost sight of that the picture you are making is to represent the original objects as they would appear if traced on a sheet of glass (the plane of delineation) placed between the spectator and the objects to be drawn. The manner most commonly in use, however, is to make the ground line of the picture and the ground line of the plane of delineation the same line; to place the position of the spectator above this line according to his distance from the plane of delineation and the plan of the original objects below it, the points of intersection of the visual rays on the ground line of the plane of delineation thus come at once on the ground line of the picture;* those points required to be brought forward to the plane of delineation are brought at the same time to the ground line of the picture. This process is a much readier mode than making the base of the plane of delineation and the ground line of the picture two separate lines, as we will show in our next figure.

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* The student must understand, that in the diagrams given in this Part of the work, as well as in the figures of the Problems in Part I. for the purpose of instruction, lines of all kinds, whether to vanishing points, to

The original object of the First Part of this treatise on perspective was to furnish information just sufficient to enable the amateur to make sketches from nature without violently outraging perspective. The forms chosen and the directions given for drawing them were as simple as the subject would admit, and the Author trusts that it is impossible for any intelligent person to go steadily through the pages without comprehending the matter. Although the present Part goes much farther into the art of perspective than the First, and the mode pointed out for representing the perspective forms of objects is different, yet there is nothing in the First Part of the work to *unlearn;* an attentive perusal of the two parts, with careful drawings made on a larger scale from the illustrations contained in both, we may venture to say, would enable the student to draw in perspective any geometrical figure set before him. It may appear to some that in giving rules for drawing a number of figures in perspective in the First Part, and leaving the explanation of the principles on which perspective drawing is founded for the Second, is, to use a homely adage, putting the cart before the horse; but perspective is generally allowed to be an extremely difficult subject to write on, as it is necessary before we can enter into the principles on which perspective drawing is founded,

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distance points, or the visual rays that are requisite for finding points of intersection,—in all cases the whole length of the line is drawn from point to point; but in the execution of a perspective drawing, where all lines for finding the form required are erased, this is not required. All that is necessary is to place the rule from point to point, and mark delicately, but distinctly, only the point of intersection required. By this proceeding a vast confusion of lines is obviated, and the progress of the drawing rendered more simple.

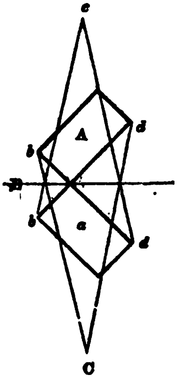
first to understand what perspective really is. To those who are ignorant of drawing, the geometrical elevation of a building appears more correct than a perspective representation, yet to those who understand the principles of drawing it must be quite evident that a geometrical elevation, however useful it may be, cannot be a correct representation of what we see, let the position of the spectator be where it may; as a simple geometrical drawing does not represent the thicknesses either of projections or recesses, though they may be ascertained generally by the depth of the shadows. The frontage of a rectangular building may be so situated with reference to the position of the spectator, as to present a rectangular figure, but all recesses or projections on the face of it must be drawn according to the rules of perspective if the representation be really as it appears, which is not done in a geometrical elevation. Hence we have preferred the system of showing practically by the most familiar examples, in the First Part, in the various figures from 7 to 15, that objects vary considerably in their form according to their change of position with reference to the spectator; that parallel lines viewed in certain directions appear to meet in a point called the vanishing point; how the position of these vanishing points may be found on the horizontal line with sufficient accuracy for ordinary sketches, with directions for determining the height of this line; and then proceeding from these premises to put a variety of figures in perspective; showing in the First Part what is meant by perspective drawing, and leaving it to the Second to point out the principles on which it is grounded. The First Part, in fact, being but an introduction to the Second, the proper understanding of which is greatly facilitated by an acquaintance with the First, some of the diagrams of the Second being difficult to comprehend without this knowledge.

In referring back to the first problem, Part I. p. 15, if we were to proceed to draw a similar figure on the principles we have described in the Second Part, which would be on the same plan as the Representation, Fig. 23, we should find that after determining the positions of the lines A, E, F by means of visual rays, and finding the positions of the vanishing points G and H, as shown in the diagrams Figs. 20 and 21, by which the inclinations of the lines D, C, H, and J are drawn, all the remaining parts may be as accurately delineated by the system described for drawing this problem, pp. 15—21, Part I., as if done by the rules given for drawing the diagrams Figs. 22 and 23, as it is immaterial as affects the accuracy of the drawing, whether the positions of the points necessary for finding the width of the windows, which were determined by means of a distance point, or the point necessary for drawing the point of the gable, which was determined by the use of diagonal lines, be found by the means used in drawing Prob. I., or whether the positions of all the points are found by means of the visual rays; whichever mode is employed the result will be the same. The point of distance is most valuable in perspective drawing, and a variety of ways are shown by different writers on perspective by which the position of this point may be determined. In the directions given for making perspective representations of objects embraced in the diagrams from Fig. 15 to Fig. 24, it must be very evident that the whole of a perspective drawing may be executed without the necessity for employing a distance point at all, the visual rays answering the same purpose; but it is frequently the case that the introduction of a distance point saves considerable labour, and the directions given for fixing its position in Prob. I. and II. Part I., and elsewhere, are sufficient for any purpose, as they will produce intersecting points on any line with as much accuracy as is to be obtained by visual rays.

If a drawing of the plan of the house, the original object of the representation, Prob. I. Part I., were given to the student, with the position of the spectator and situation of the plane of delineation, it is barely possible he could have any difficulty in putting in perspective the parallelograms of the two sides of the house, formed by the lines A, D, F, K and A, C, H, J; the heights of all the different parts being the same as described for drawing the first problem, Part I. In the cut (Fig. 27) we have here introduced, we have placed the plan of the building below the ground line, so as to bring the intersections of the visual rays direct to it; this will prove a great saving of labour; but it is necessary to point out, that in all cases where this is done, the plan must be drawn the reverse way to that where the base line of the plane of delineation and the ground line of the picture are distinct lines, which has been the case in all our previous examples. This will be understood, by turning the figure 27, upside down; in looking at it in this position, taking the ground line of the representation as the base of the plane of delineation, if the points of intersection on it were carried to another line as the ground line of the picture (similar to the diagrams, Figs. 22, 23), the gable end would be to the right hand instead of to the left, the way we absolutely see it.

It is not our province to enter into any theories; all that is required is to make the student understand as a practical fact, that where the plan is placed underneath the picture, so that the base line of it (the ground line) is used at the same time as the base of the plane of delineation, the plan must be drawn reversed; by making the ground line serve both purposes, we gain a saving of labour, which is always an object. The annexed diagram shows that the result will be the same, whether we use a distinct line for the base of the plane of delineation, carrying the intersecting points to the ground line of the picture, drawing the plan as it stands before us, or whether we make one line serve the purpose of both, by drawing the plan reversed. Let A represent a plan similar to that in Fig. 27, only drawn as it stands before us, B representing the plane of delineation, from which the points are to be carried to the ground line of the picture, C the position of the spectator. The plan *a* is A reversed, and the point *c* is in the same relative position to *a* as C to A; the line B serving for the plan *a* and station point *c*, both as ground line of the picture and base of the plane of delineation; the visual rays *b* c and *d* c, it will be seen, intersect the line B in the same points as the visual rays *b c* and *d c*. In comparing figure 27 with Plate II. of the First Part, it will be seen that the lines E and J in the plan, are the lines by which the positions of the vanishing points H and J are determined; the angle A of the house touching the plane of delineation, is of course drawn perpendicularly up from the point 2; the perpendiculars E and F are determined by the visual rays drawn from *a* and *b* to the station point of the spectator ⊙; the lines C, J, D, and K, are drawn as in Fig. 23, Representation.* The points by which the perspective width of the windows was determined in drawing the house in Prob. I., was by means of a distance point, full directions for the manner of determining the position of which, were given in the directions for drawing that problem; and we here propose to show that the result of finding them by this means is precisely the same as if the visual rays had been used. The distance from 1 to 9 in this diagram (Fig. 27), will be found to be really the geometrical length of the perspective line D, by comparing it with the line K of the plan, and the divisions 10, 11, 12, 13, correspond on the two lines R and K. From each of the points 10, 11, 12, 13, on K of the plan, draw a visual ray to the station of the spectator, intersecting the ground line (also the plane of delineation) at *c*, *d*, *e*, *f*.† From the point 9 through the

Fig. 28.



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* As regards the *height* of the line A and the height of the windows, the manner of determining them was fully explained at p. 20, Part I.

† In this figure, to avoid confusion of lines, the visual rays are not drawn to the station point through the ground line, but only up to it;

corner of the house, *b*, draw a line to the horizontal line, to determine the point of distance, S;* then from each of the points 10, 11, 12, 13, on R, draw a line to the distance point S, to determine the perspective positions of these points. If we now from each of the points on the ground line, *c*, *d*, *e*, *f*, draw a perpendicular line up to D, they will be found to intersect that line in the same points, as the lines drawn from the points 10, 11, 12, 13, on R, to the point of distance S, proving that the positions of these points are determined with as much accuracy by means of a point of distance, as by drawing the visual rays.

In Prob. I. Part I., the perpendicular line dividing the parallelogram A, C, E, J into its perspective halves, was found by means of the intersection of the diagonal lines L and M at the point 7; we shall find this mode for drawing the perpendicular line N at its perspective distance from A and E, equally correct as employing either a visual ray or a point of distance. The point *g* on the plan is exactly midway between 2 and *a* on the line J; if from this point a visual ray is drawn to the ground line at *h*, a perpendicular line drawn from it will pass directly through the point 7 found by the intersection of the diagonals L and M. Again, from the point 1 on A, a horizontal line 1 *j* is drawn to represent the geometrical length of the line C (equal to J of the plan); if from *j* through the point 3 a line is ruled to the horizontal line, it will give a point of distance T, by which the width of any details on the gable end of the house may be determined on the line C; thus, if from the point *k*, the half of the geometrical representation of C, a line is drawn to the point of distance T, the intersection of it with the line C determines the perspective centre, and is in the same point with the

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were it not a figure for instruction, even this would be unnecessary, as simply marking the points of contact at *c*, *d*, *e*, and *f*, would be sufficient.

* All the references in this figure that occur in Prob. I. Part I., are lettered and figured the same.

intersection produced by the perpendicular line from 7 and *h*. Hence it must be clear, that to determine the perspective distance of any perpendicular line between A E or A F, it is immaterial, so far as correctness is to be obtained, whether these distances are determined by a distance point, by visual rays, or by means of diagonal lines.*

It is difficult to say of these three modes, which is the best; in some cases one is to be preferred, in others another. The distance point and the diagonals are the most used in sketching from nature, as it is seldom found necessary to construct a plan, the general outline and position of the vanishing points being taken at discretion. In minute parts of a drawing, the use of the point of distance is valuable, as correctness is more readily attained, and it saves much trouble where a perspective line is required to be divided into a number of equal parts, to use the point of distance instead of visual rays, as will be seen on the line drawn from *l* (on A), to the vanishing point H. Suppose that portion of the line from *l* to *m*, required to be divided (perspectively) into four equal parts: draw an indefinite horizontal line from *l*, and set off four equal parts at *n*, *o*, *p*, *q*; from *q* draw a line to the horizontal line at U; these lines drawn from *n*, *o*, *p*, to U, will give the perspective positions of these points on *l*, *m*. The reason why the distance point is more convenient for this purpose than the visual rays from a line on the plan, is, first, that you may place your distances on the horizontal line at discretion, and secondly, that by being able to get them wider apart, correctness is more easily attained. Suppose the distance chosen to have been a trifle more than from *l* to *n*, as from *l* to *r*, the horizontal line would extend to *u*, and the point of distance must be found by drawing a line from *u* through *m* to the horizontal line at V, and lines ruled from the intermediate points *r*, *s*, *t* to the point of distance V,[*] will intersect the line *l m* in the same points as those drawn from the points *n*, *o*, *p*, to the point of distance U. It may be well here to notice, that from any point on A from which a line is drawn to the vanishing point, the point of distance may as readily be determined as from the point (1) chosen; or that the point of distance being fixed from the real geometrical length of the line B, measurements may be made on any other line, and the same point of distance made use of; as if we required to divide the perspective line *k* in half, we have only to measure off on the ground line to the right of the point 2, the geometrical half of the line K of the plan, and a line ruled from it to the point of distance S, would intersect the line K in the middle; this is clearly shown in the geometrical width of the first arch on the line B and the ground line, Fig. 1, Prob. VI. Part I. In the second problem, Part I., the student could have no difficulty in finding the positions of the points 3 and 4 from a plan; and as the near edge of the chess-board is on the ground line, and therefore up to the plane of delineation, the line 1 2 has only to be divided into eight equal parts to get the divisions of the squares. It must be evident in this figure, that the point of distance is the readiest way of determining the perspective positions of the points from *a* to *g*; if these were to be found by means of visual rays, it would be necessary to divide one of the sides of the plan into eight equal parts, to draw a visual ray from each to the ground line, and from each intersection draw a perpendicular line to intersect either the line 1—3 or 2—4; whereas in the manner adopted in Prob. II. (the point 3 having been found by a visual ray), the point of distance is determined by a line from 2 through 3 to the horizontal line, and the intermediate points between 1 and 3 are found by one operation.

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* The diagonal lines may be used for finding the positions of other perpendicular lines besides the middle line N, as shown in the First Part, Prob. IV. Plate 5.

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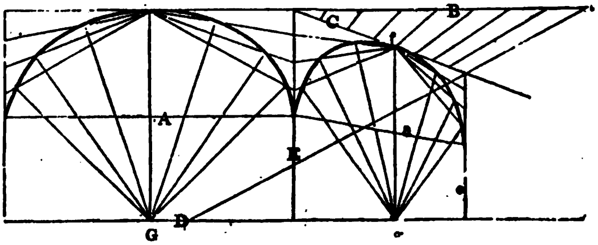
[*] This point is out of the picture as well as the vanishing points, but it would be found on the horizontal line by continuing the line *u m* V up to it.

In Prob. X. Part I. we pointed out the mode (pp. 56, 57) for finding the perspective width of recesses, leaving the first step, the distance of the line 2 from 1 to be determined by eye; in this figure (27) we shall show with what readiness the depth of the recess may be determined by rule. Let *v* on the plan represent the plan of the recess; we shall then require the perspective width of from *w* to 11; to ascertain which, draw a visual ray from *w* intersecting the ground line at *x*, and from *x* draw a perpendicular line across the front of the house; the perpendicular from *d* is the line 1 of Prob. X. Part I., and the perpendicular from *x* the line 2 of the same. In this figure (27) we have not introduced the top and bottom lines of the windows, as the manner of proceeding for drawing these is fully described in the directions given for drawing Prob. X. Part I. We have merely shown how the line 2 (Prob. X.) is to be found by a visual ray from a plan; that being determined, proceed as described, p. 56, Part I., from the corner of the window 4.

The same remarks we have made in comparing Fig. 27 with the first problem in Part I., will apply to other plates in the same part; thus, in Fig. 1, Prob. VI., if the plan were given so as to fix the position of the vanishing point and determine the distance of the line D from A, the width of the piers and arches, and the intermediate points required for drawing the curves, are as readily found by means of a point of distance as by drawing visual rays to the plane of delineation. The readiest way of drawing this figure, would be to find the width of the arches and the middle line between their sides, by the visual rays, and find the points for the curves as described in Fig. 2, Plate 7. If in addition to what is represented in Prob. VI., the thickness of the arches was required to be drawn as in Prob. XI. Part I., the thickness shown from A to *a* (Prob. XI.) would be determined from a plan, in a way similar to finding the perspective depth of the recess 11 to *w* in Fig. 27.

In the diagrams introduced in Part II., none have been given for the representation of curves in perspective; ample information has been given to enable the student to construct any plane rectilinear figure in perspective; and as rectilinear figures must first be constructed in order to find intersecting points through which the curves are to be drawn, it was considered that the introductory observations and subsequent examples in Chap. III. Part I., were quite sufficient to enable the student from a plan to draw a circle in perspective; the geometrical figure required for so doing, being only a few straight lines intersecting one another at certain points, and all within a square. There are a variety of geometric curves, such as the ellipse, parabola, &c. &c., that, if the mode for geometrically constructing them according to the rules laid down in works on practical geometry are known, are as easily put in perspective as the circle, although a greater number of lines may be required. These curves are met with in arches, roofs, mouldings, &c., and as we before said, if the manner of constructing these figures geometrically is understood, they are readily put in perspective. We will introduce one example by putting a semi-elliptic arch in perspective.

Fig. 29.



The rule for drawing this geometric curve is to be found in Nicholson's "Practical Geometry;" it is very simple, and produces a good line. It must be understood that to draw this figure on a large scale, it would be necessary to take, in proportion to the size it is to be drawn, an increased number of points; four points are very few to get a perfect line, but are quite sufficient to illustrate the principle on which this or any other curve may be represented in perspective. It is superfluous to draw any plan for this figure, the parallelogram containing it being drawn in perspective as any other parallelogram would be; we therefore premise all that preparatory work to have been gone through, and proceed at once to the representation of the curve. The geometrical divisions on A must be carried to the line B, and their perspective positions found on C by means of the point of distance D on the horizontal line, and from C, these points must be brought to the line *a*,* the representation of A in perspective. The divisions on the line E must be put on the line *e*, by ruling to the vanishing point from E through *e* to it; this will give all the points requisite for drawing the rectilinear figure in perspective; and by drawing from *f* to the points on the perpendiculars on each side of the parallelogram, and from *g* through the divisions on *a*, lines up to those from *f* to the divisions on the sides, similar to the geometrical figure to the left, all the points requisite for drawing the curve will be evident; the rectilinear figure to the right being the perspective representation of the rectilinear figure to the left.

Our limits do not admit of introducing any great variety of figures; indeed the object is only to point out the principles on which perspective drawings are to be made from details of individual parts. In Prob. VIII. Part I. we have given a figure by which the shaft of a column, and consequently a series of shafts of columns, may be drawn; frequently the shafts of columns are of a less diameter at the top than at the bottom; to represent such a shaft in perspective, it would require only to construct a perspective square within the top square E (see Figs. 6 and 7, Plate 13, Part I.), the same width as the diameter of the top of the shaft, draw the circle within it, and from the extremities of the bottom draw lines to the extremities of the top, similar to the lines S and T, Prob. VIII. In the forms of the roofs of interiors, we constantly meet with arches crossing each other in a variety of ways. It is as easy to draw an arch in perspective in one direction as another: it is only necessary therefore to fix the points from which the arches spring, ample information for doing which has already been given, and the arches, whatever may be their geometrical form, are as easily drawn as in Prob. VI. and IX. The annexed diagram (Fig. 30) is an example of the effect produced by the intersection of arches. It would be superfluous to show how these perspective arches were constructed, as it would be only a repetition of preceding examples; the points from which the curves spring are similar to 1, 3, 6, 9 of Prob. VII. Part I., the arches springing from 1 to 9 and 3 to 6, instead of from 1 to 3 and 6 to 9. Domes vary considerably in their apparent forms, according to the change of position from which they are seen, and to the experienced eye a want of perspective knowledge is easily detected in their representation. There is little difficulty in drawing in perspective any form of dome, provided the student understand thoroughly how to draw the geometrical figure, as we will show by a reference to Prob. V. Part I., and Fig. 29, just given. Let us suppose the form of the dome to be that given in Fig. 29, springing from eight points, and we had

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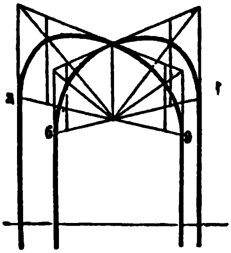
* It would be a shorter process to continue the line A, and there place the geometrical divisions (as on B); by which proceeding, the divisions got by the point of distance would come at once on *a*. We have taken the line B, because, being obliged to leave the lines required for finding the positions of the points, the finding them from a continuation of the line A would have created a confusion with the other lines.

Fig. 30.

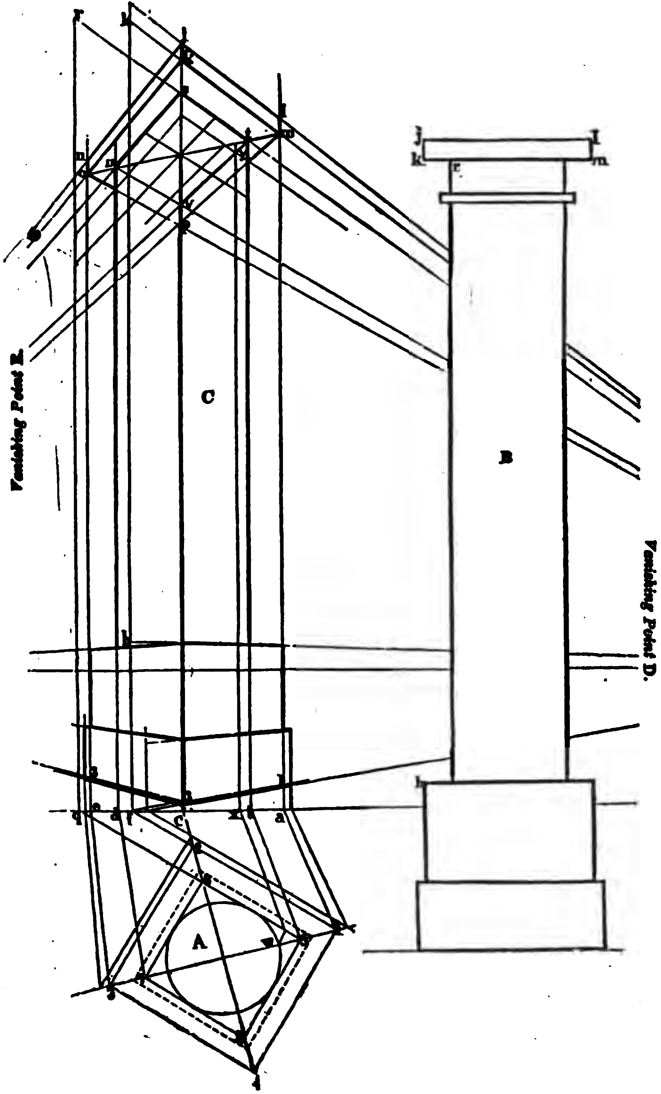


drawn the plan of it similar to the nearest perspective circle, Prob. V. First draw a perpendicular line from the perspective centre of the circle (the intersection of the diagonal lines), the height of A F, and on the line 4—2 construct a geometrical figure similar to Fig. 29; then, as described in Fig. 29, draw the geometrical figure in perspective over each of the lines 1—3, 5—7, and 6—8, as bases representing the line A, and the result will be an accurate representation of such a dome in perspective, as was described. Irregular curves may be represented in perspective in the same manner as described for Fig. 29, constructing your own rectilinear figure about the irregular curve to get a number of intersecting points in it, and putting this figure in perspective; this would be required in drawing the leading lines of leaves in a Corinthian capital. Any spiral from the volute of an Ionic capital would prove an excellent example for the student's exercising himself on the principles for representing curves in perspective.

CHAPTER VI.

At the commencement of Chap. V. p. 107, we remarked that the mere outline of the ground plan of a building would be insufficient as a plan from which to make a perspective drawing, and that we require for this purpose a series of plans made from horizontal sections of the various parts wherever any change of form occurs either as a projection or recess; thus in the projections of roofs, pediments, cornices, mouldings, &c., the form and extent of the projection must be drawn on the plan before we can put it in perspective. Fig. 31, p. 141, represents the plan (A), elevation (B), and perspective representation (C), of a square pillar standing on a cube, with a projecting top, or capital; the station of the spectator is marked at ⊙, to which point visual rays have been drawn from the three corners of each of the squares of the plan that are visible, the inner square being the plan of the shaft of the pillar, and the outer square the plan of the projection (the projection of the base and the capital being the same), and from each of the points of intersection *a*, *b*, *c*, *d*, *e* on the ground line of the picture, a perpendicular line has been drawn; the point 2 has been brought to the ground line at *f*, and a line drawn from *f* to the vanishing point D, gives the perspective position of the point 2 of the plan at 2; the cube forming the base of this figure is drawn as Fig. 23, only as the top of it is above the eye of the spectator, only the outer edges of it are visible. The perpendicular line from *f*, by which the perspective height of the base was determined at *h*, must be continued up, and the geometrical heights *j k* marked on it from the elevation, from each of which points a line must be ruled to the vanishing point D; the intersections of these lines with the perpendiculars drawn from the points *c* and *a*, will give the perspective positions of the points *j*, *k*, *l*, and *m* of the elevation, and perspectively perpendicular over the points 1 and 2 of the plan; from the points *j* and *k* lines must be drawn to the vanishing point E, their intersections with the perpendicular drawn from *e* determine the perspective positions of the points *n* and *o* perpendicularly over the point 3. Draw a line from the point *m* to the vanishing point E, and from *o* to the vanishing point D, intersecting each other in the point *p*, then *k*, *m*, *p*, *o* would be the representation of the under surface of the slab or capital on the top of the square pillar, perpendicularly over the points 2—1—4—3 of the plan. On this perspective square we have now to represent the inner square of the plan in perspective, the top of the pillar on which the square slab just drawn stands; continue the line

Fig. 31.



5—6 up to the ground line at *q*, from which draw a perpendicular line, and from the elevation set on it the geometrical height of the pillar at *r*, from which point draw a line to the vanishing point D, the intersection of this with the perpendicular from *c* gives a point, *s*, perpendicularly over the point 8 of the plan; its intersection with the perpendicular from *b*, gives a point, *t*, perpendicularly over the point 5 of plan; from *s* draw a line to the vanishing point E, its intersection with the perpendicular line from *d* gives a point, *u*, perpendicularly over the point 7 of the plan, and completes the perspective representation of the elevation B from the plan A required.

The mode employed for finding the positions of the points *s* and *t* by setting up the geometrical height of the pillar at *r*, is perfectly correct, and serves excellently as an exercise on our previous examples; but a much readier and equally correct mode of proceeding would be to find their position by means of a diagonal line between *m* and *o;* the points *t* and *u* being perpendicularly (that is, perspectively speaking) over 5 and 7, the diagonal *m*—*o* must give these points in its intersections with the perpendicular lines from *b* and *d*. If the points *t* and *u* had then been determined by the diagonal *m*—*o*, the lines *s*—*t* and *s*—*u* would have been drawn on a different system; from the vanishing point D a line must have been ruled upwards through *t*, and from the vanishing point E a line ruled through *u* to intersect the last drawn, which would be in the same point on the perpendicular drawn from *c*, found by the visual ray from the point 6.* Any additional projection may be put in perspective by drawing it first on the elevation, and afterwards the horizontal section of it on the plan; thus narrow fillets, such as are constantly placed on pillars a little below the capital, may be represented in perspective with very little trouble, on the same system as was employed for drawing the base and capital;—such as the one we have drawn on the elevation and introduced on the plan with dotted lines.*

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* The visual rays drawn from all the points, 2, 6, 8, 4, are in the same line, and consequently the perpendicular line drawn from *c* answers for the perpendicular angles of any number of parallel squares when the visual ray is in a direct line with a diagonal; had the station of the spectator been either to the right or left of the position in which we have placed it, the angle *j k* of the slab would not have been perpendicularly over the angle *s* of the pillar.

It is best generally in drawing the plans from which perspective drawings are to be made, to draw the largest surface first, whether it stands on the ground, or is the section of some projecting part over it; we have, however, in the figure before us, departed from this rule, in adding to the representation the projecting piece round the lower part of the cube on which the pillar stands. This is done to show the student that he must occasionally add to his plan from the elevation as he proceeds: thus the width of this projection is taken from the elevation and set on the plan outside the outer square, 1, 2, 3, 4, already drawn, and the projection is put in perspective by exactly the same process as the cube standing over the square 1, 2, 3, 4. In the plan of this outer square only two sides have been drawn, as they give the three points that are required: the other two sides it would be a waste of labour to introduce.

Let us suppose that instead of the square pillar standing on the cube of the base, there stood a circular column, the diameter of which is the same as the width of the square 5, 6, 7, 8; from the centre of the plan describe a circle to represent the plan of the column within the square 5, 6, 7, 8; from the point *u* in the perspective representation draw a line to the vanishing point D, and from the point *t* draw a line to the vanishing point E; the intersection *v* of these two lines gives the fourth point in the perspective representation of the square 5, 6, 7, 8 at the height *r* of the elevation. The student must now turn back to Prob. VIII. (facing p. 45, Part I.), and refer from this figure (31) to that problem in the following description. From the point *w*, the intersection of the circle with the diagonal 5—7, draw a line parallel to 5—8 up to the line 5—6; from this point draw a visual ray intersecting the ground line at *x; from x* draw a perpendicular up to the line *t*—*v* at *y*. From the vanishing point D, through *y*, draw a line to intersect the diagonals *t*—*u* and *s*—*v;* where this line intersects *t*—*u* it gives a point corresponding with the point 2 of the diagram, Prob. VIII.; where it intersects *s*—*v* it gives a point corresponding with 8 of the diagram; from each of these points draw a line to the vanishing point E; the intersection on *t*—*u* will give a point corresponding with 6 of the diagram, that with *s*—*v* a point corresponding with 4. From each of the vanishing points D and E draw a line through the intersection of the diagonals *t*—*u* and *s*—*v;* where the line drawn from E intersects the line *u*—*v*, it gives a point corresponding with the point 5 of the diagram, Prob. VIII.; where it intersects the line *s*—*t* it gives the point 1 of the diagram. Where the line drawn from D intersects the line *t*—*v* it gives a point corresponding with the point 3 of the diagram; where it intersects the line *s*—*u* it gives the point 7 of the diagram. Here it will be seen that we have the eight points required through which to draw the curve of the top of the circular column in perspective, without the necessity for drawing the whole figure of the diagram, Prob. VIII., on the plan: the points 6, 8, 2, 4 being all determined from the single point *w*, and the points 3, 5, 7, 1 from the intersection of the diagonal lines *t*—*u* and *s*—*v;* it was even superfluous to draw in the plan the whole of the circle; marking from the intersection of the diagonals 5—7 and 6—8 the length of a radius on the diagonal 5—7 at *w* would have been quite sufficient. The curve may be drawn through these points, and the sides of the column drawn down similar to the lines S and T from the curve R, Prob. VIII. Part I.

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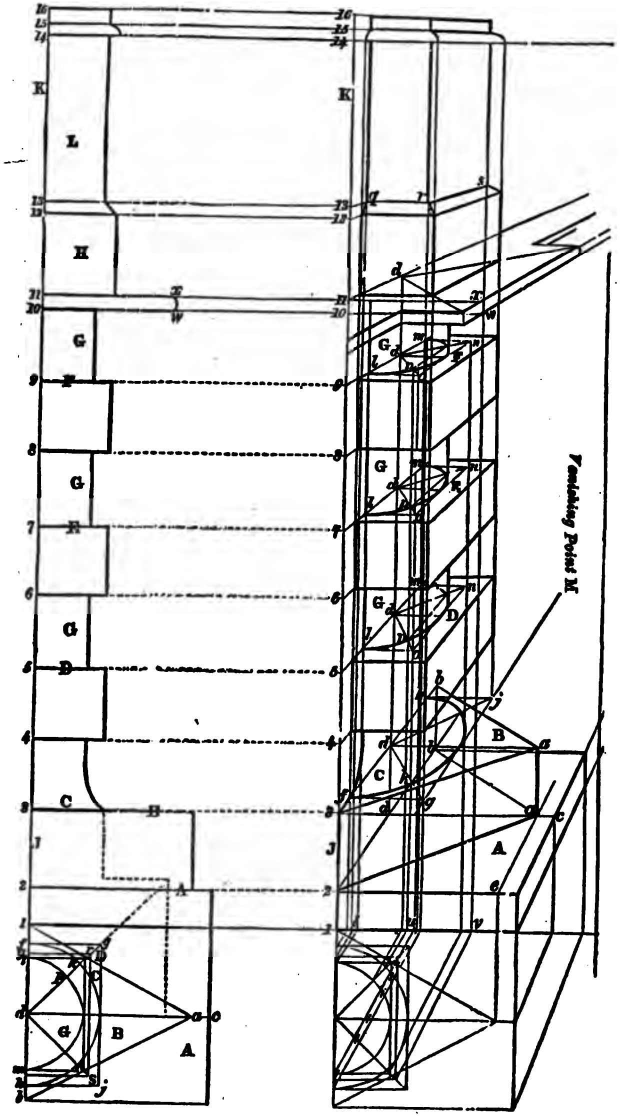
* This fillet we have not introduced in the perspective representation, as the lines necessary for so doing would interfere with those we shall require for another illustration; and, as we have observed before, we have not the advantage of being able to erase our lines as we proceed. It may be done in the same way as a projection we are about to draw round the base.

In the foregoing illustration (Fig. 31) we have shown by a very simple figure how the projections of any original object are represented in perspective from a plan introducing the sections of the projections where they occur, all of which, save the circular column, are of the same form, viz. squares; we now present the reader with an example admirably adapted not only to illustrate the same, but also as an excellent exercise for the student on all the examples given in the two parts of this work. The student on looking at this figure must not be alarmed at its apparent intricacy: there is not a line in it but what has been explained in preceding drawings, and if each portion of the figure be examined separately, and looked at as a distinct figure, all intricacy will vanish: the square block forming the base is drawn by the same rules given for the cube in previous examples; the triangular solid that stands on it is equally simple; the directions for drawing the half-circle on the top of this last figure were explained in the First Part (Prob. V. &c.); the blocks forming semicubes are as simple as the earliest examples we have given in this Part; and the mode for drawing the semicircular forms made by the shaft passing through these blocks was amply illustrated in Prob. VIII. The projecting parapet and pier standing on it is but a variation of the last figure, and if we only hide with a piece of paper all the under part, it will appear equally simple. It is the imperative necessity for our leaving *all* the lines required for constructing our figure that makes them appear complicated; whereas the student in his progress will be able to erase the lines that are used in the construction of one figure before he proceeds to the next, by which his proceedings will be divested of all confusion of lines. Before commencing this figure, the student must recollect that in our progress we have frequently observed, that for the purpose of instruction we have been compelled to introduce more lines than were absolutely required for the construction of the figure, and also we have in numerous cases pointed out that a result equally correct is to be obtained by a variety of modes of proceeding; therefore in the construction of a figure like the present, consisting of a combination of parts, dissimilar in form, one part may be drawn by means of visual rays for finding the positions of the various points, and the points requisite for drawing the next may be determined by that previously drawn; the mode that produces a correct result with the fewest possible number of lines is always the most desirable.

In this figure, for the advantage of more clearly understanding the references, we have placed a plan both under the elevation and perspective representation, the manner of drawing which we are about to describe; and in order to afford every facility to a perfect understanding of the figure, every alternate form is drawn with dotted lines. The original object, the buttress of a bridge, is viewed from a recess on the bridge looking over the parapet, which necessarily causes the horizontal line to be placed very high. This position is chosen, as it presents a larger surface on which to represent the several figures.

We will in this representation take each part of the buttress separately, treating each as a distinct figure, and before the student commences his perspective drawing, he should on a large scale copy the elevation and plan below it, carefully marking all the letters and figures for reference, drawing on the plan for constructing his perspective figure each part as it is described; he will also find his progress through the drawing much simplified by putting in each figure when completed with ink, and rubbing out all the surperfluous pencil lines. We commence then with the square base marked A. It is quite unnecessary to give any directions for drawing this figure, as it would be but a repetition of what has been already fully explained; all the lines, however,

Fig. 32.


16
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Vanishing Point M
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that were used for drawing the perspective form are left on the representation for the advantage of the student.* The second, which is a triangular figure, might have been drawn by finding the vanishing points from the lines 1 *a* and *b a* of the Plan; but as the perpendicular planes over these lines are the only planes standing in these directions, the triangular figure may be drawn by a much shorter process. From the point *c*† draw a visual ray to find the position of *c*‡ on the top of the perspective square A, from which draw a line parallel to the ground line across the square, which will give the point *d* on the line 2 *b*; from *d* draw a long perpendicular line, as the position of this point will be required in every portion of the figure; from *a* draw a perpendicular line to *e* (the geometrical projection of this triangular figure), and from *e* a line to the vanishing point, the intersection of this with the line *c d* gives the position of the point *a* on the plane A; draw the lines 2 *a* and *a b*, which will give the perspective form of B of the Plan on the plane A. From each of the points 2, *a*, *b*, draw an indefinite perpendicular line, bring from the elevation the point 3 to the line of projection J K, and from it draw a line to the vanishing point; from the point of intersection *d* on this line draw a horizontal line to the perpendicular from *a*; join the points 3 *a* and *a b*, which will complete the perspective drawing of the second figure. To draw the form of the third figure on the plane B, we must first find the positions of the points *f* and *h* on the line 3 *b*. This is done by visual rays drawn from these points from the plan to the ground line, and the perpendiculars from the points of intersection will give the points *f* and *h* on the line 3 *b*. Continue the horizontal line to the right of the point 3, the length of the radius of the circle (*d f* of the Plan), and from its extremity draw a line to the vanishing point; then from each of the points *f* and *h* draw a horizontal line to meet the last drawn at *g* and *j*; this will give the perspective half-square in which to describe the semicircle. Draw the semi-diagonals *d g* and *d j*; the semidiameter is already drawn by the line *d a*; it remains only to find the perspective positions of the points of intersection made by the curve on the semi-diagonals to enable us to draw the figure; from *k* (on the Plan) draw a visual ray to the ground line; a perpendicular drawn from the point of intersection will give the perspective position of the point *k* on the semi-diagonal *d g*; a line from this point *k* to the vanishing point will give a corresponding point on the semidiagonal *d j*. The curve should now be drawn through the several points, which will be the perspective form of the semicircle C of the Plan on the plane B.

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* The student will bear in mind, that the plan being drawn *below* the ground line, the figure is reversed.

† In order to curtail as far as possible the quantity of lines that are unavoidable in making a perspective drawing, we have drawn this figure in parallel perspective, and the plane of delineation right up to the nearest face of the base figure; by so doing, we are enabled to get the measurements of the heights on the line J K (which may be called the line of projection) of the representation direct from the same line in the elevation.

‡ The letters for reference are made on the plan of the elevation, but the lines representing the visual rays are drawn from the corresponding points on the plan under the perspective representation. The letters in the perspective representation indicate points that are perpendicular over the points, with similar references in the plan at whatever height they may occur.

The fourth, sixth, and eighth figures are all of the same form, being projections of half-cubes. It will be seen, or referring to the plan and elevation, that the perpendicular angles of these figures are over the points *f*, *g*, *h*, *j*; the positions of these points having been determined on any one plane, their positions on any other will be perpendicularly over (or under) those already found; therefore from each of the four points *f*, *g*, *h*, *j* on the plane B draw up an indefinite perpendicular line, then bring each of the points 4, 5, 6, 7, 8, 9, to the line of projection for the perspective representation, and from each of the points draw a line to the vanishing point; the lines drawn from 4 and 5 at their intersections with the perpendicular from *f*, determine the height of the perpendicular angle of the half-cube D standing over *f;* horizontal lines from these points of intersection to the perpendicular line from *g* determine the height of the angle over *g;* from the points of intersection on the perpendicular from *g*, draw lines to the vanishing point, their intersections with the perpendicular from *j* determine the height of the angle standing over *j;* from the highest intersecting point on the perpendicular from *j* draw a horizontal line to meet that drawn from 5 to the vanishing point, which will complete the perspective drawing of the half-cube D; the drawing of the two other half-cubes is a mere repetition, substituting in the directions above given the figures 6 and 7, or 8 and 9, for 4 and 5.* The process for drawing the semicircles on the planes D, E, and F is the same as that for drawing the semicircle on the plane B; the positions of the points *l* and *m* (of the plan) must first be found on each of the lines drawn from 5, 7, and 9 to the vanishing point; we must therefore draw visual rays from these points *l* and *m* on the plan to the ground line, and draw up perpendicular lines from the points of intersection; these will give on the lines drawn from 5, 7, and 9 to the vanishing point the perspective positions of the points *l* and *m* on each; the position of the point *d* is already determined by the perpendicular drawn from *d* on the plane A; draw then from each of the points *l* and *m* a horizontal line across the several planes. From *n* on the plan draw a visual ray, and from the point of intersection on the ground line a perpendicular, which will give on the horizontal lines drawn from *m* points on each of the planes D, E, and F, corresponding with the point *n* on the plan; from the vanishing point through the points *n*† draw lines to meet the horizontal line from *l*, which will give the points on each plane corresponding with the point *o* of the plan; draw in each figure the lines *d n* and *d o*, on which we have to find the points through which to draw the curve. From *p* (on the plan) draw a visual ray, and from the point of intersection on the ground line a perpendicular, which will give the perspective positions of the points *p* on each of the semi-diagonals *d o;* from each of the points *p* draw a line to the vanishing point, which will give a corresponding point on each of the semi-diagonal lines *d n*. All the points being determined through which the curve passes, the curve should be drawn on the respective planes, and a perpendicular line from the extremity of each curve to the right to meet the projection above it.

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* The three half-cubes are treated as one figure, also the shaft passing through them, all the points required for drawing the semicircles on the upper planes of the three half-cubes being determined by one process.

† From either of the points *n* or *o*, a visual ray might have been

We will pass by for the present the projecting parapet, and proceed to the pier standing on it; the perpendicular angles of the base of this figure, as may be seen by the plan and elevation, are perpendicularly over the angles of the three half-cubes, and must consequently come on the perpendiculars drawn from the points *f*, *g*, *h*, and *j*, on the plane B; therefore bring the points 11 and 12 of the elevation to the line of projection, and put the base of the pier in perspective, according to the directions given for the half-cube D. The perpendicular angles of the portion L of the pier not projecting so far as the angles of the base, the lines representing them must be found by visual rays, which must be drawn from the points *q*, *r*, and *s* of the plan to the ground line at *t*,

drawn to have determined their perspective positions; the point *n* was chosen, and the point *o* found from it by the vanishing lines *n o*, to avoid confusion. These points *n* and *o* might have been determined in a different manner, by drawing semi-diagonal lines from the points *d* to the corners of each of the planes D, E, and F; the intersections of these semi-diagonal lines with the horizontal ones drawn from *l* and *m* would be in the same points *n* and *o*; this indeed would prove the readiest way of determining these points, as it would at the same time have given the semi-diagonals *d o* and *d n*, which are required for drawing the curve.

u, and *v*, and perpendicular lines drawn from each; carry the point 13 to the line of projection, and from it draw a line to the vanishing point, the intersection of this with the line drawn from *t* will be the point *q* (perpendicularly over the point *q* of the plan at the height marked 13 of the elevation); from *q* draw a horizontal line to the perpendicular from *u*, this will give the perspective position of the point *r* of the plan at the height marked 13; from *r* to the vanishing point rule a line to the perpendicular from *v*, the intersection will give the perspective position of the point *s* of the plan at the height 13. The sloping lines from the points *q*, *r*, and *s* must be ruled to the top of the angles of the base of the pier. The line from the base of the projection 14 must be drawn precisely in the same way as the lines of the base of the pier from 11 and 12, the points of this projection being perpendicularly over the points *f*, *g*, *h*, *j*; the lines got from 15 and 16 similar to the line from 13, and the projecting angles from the extreme points of projection.

The *plan* of the parapet on which the pier stands, from our limited space, we cannot introduce so as to get our points from it by visual rays; we have, however, in very faint dotted lines on the plan under the elevation, shown what the projection is, sufficiently to understand our manner of drawing the perspective representation; the points 10 and 11 are placed on the line of projection, and the horizontal lines from them continued to the right to *w* and *x*, their geometrical length; through each of these points, in a direction towards the vanishing point, we have ruled lines to the right and left; from the point *d* on the plane of the top of the parapet, through the angles of the base of the pier, draw lines to meet the line drawn through *x*, to determine the corners of the projection in front of the pier (see the dotted lines in the plan); from each of the points of intersection on the line through *x* draw a parallel line to meet the continuation of the base line of the pier; the intersections determine the points from which the projection commences. The under line of the projecting parapet showing its thickness, it is unnecessary to describe, the several points lying perpendicularly under those of the upper one.

We have taken considerable pains to make the directions for drawing this figure so clear as to enable the student to draw any other figure composed of a variety of parts of dissimilar forms by a reference to it. The small space afforded by a page of this work precludes the possibility of introducing more than one buttress in the representation; in the single one given, the lines are necessarily so close together that great care is required in attending to the references; we wish, however, to point out how any number of these buttresses, forming the piers of a bridge, may be drawn in succession, with the arches between them, with the fewest possible quantity of lines; this we will explain by referring to Prob. VI. Plate VII., of which we will suppose from A to *b* the width of the buttress (from 1 to *b* of the Plan, Fig. 32). On the perspective representation of any horizontal line crossing these spaces between the arches, the perspective positions of the points *f*, *q*, *l*, *d*, *m*, *r*, and *h* must be found on each, whatever may be the number of piers; the positions of these points may be determined either by visual rays from a plan, as in the figure just drawn, or from geometrical measurements on a line of projection by a point of distance, as from the line E to the line B, Prob. VI. The positions of these points being determined on a (perspective) horizontal line on each pier, a perpendicular line should be drawn through each, the whole length of the structure from top to bottom, and the several points 1, *f*, *q*, *l*, *d*, *m*, *h*, *b*, lettered on the base or top line of each pier; then continue across the whole face of the structure the lines to the vanishing point from the points 1 to 16 inclusive; by these two operations the perspective positions of all the points are determined that are requisite for drawing the different projections of the buttress from each pier. Suppose, as in Prob. VI., the structure consists of five arches* and six buttresses, the nine points from 1 to *b* found, and perpendicular lines drawn through them on each pier, with the references put on the base line of the structure.† The lines drawn to the vanishing point (which for brevity we will call M) from the points 1 to 16 on the line of projection, J K, will give on the perpendicular lines over the points 1 on each pier, points corresponding with those on the line of projection; as the lines drawn from 2, 3, 5, 7, and 9, will give the corresponding positions on the perpendicular line from *d* on each of the more distant piers, the points *d* required for drawing the different figures on the first pier. If from the point *d* on the line 2 M of each pier a horizontal line is drawn to meet the line *e* M, it will give the position of the point *a* on the plane A of each buttress; a perpendicular from each of these points *a* intersected by horizontal lines from the points *d* on the line 3 M, will give the position of the point *a* on each of the planes B; the lines 2 *a* and 3 *a*, and the line *a b* of the plane B, may now be drawn on the buttresses, the points required for drawing them being determined on each pier. Horizontal lines drawn from all the points *f* and *h* to meet the line *g* M, will determine the points for drawing the half-square *f g h j*, in which to describe the semicircle C of the plan, projecting from each pier. In each of these half-squares the diagonals *d g* and *d j* may be drawn, the points required, *d*, *g*, and *j*, being determined in each, the semi-diameters being already drawn in finding the points *a*; the line *k* M gives the intersecting points on each of the semi-diagonals *d g* and *d j*, through which the curve is drawn.

It is unnecessary to recapitulate the process for drawing each separate figure on the further piers; the perpendicular line standing over the point 1 on each being a representation of the line of projection J K, with its divisions from 1 to 16; the rectangular figures are drawn exactly as described for the first buttress; and the semicircles on the planes D, E, and F, as the semicircle C on the plane B just described, substituting the letters *l*, *m*, *n*, *o*, for *f*, *h*, *j*, *g*, and after drawing the semi-diagonals *d o* and *d n*, the letter *p* for K.

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* It is needless to introduce any further observations on drawing the arches between the piers. Reference may be made to Prob. VI. IX. and XI. Part I., and to Fig. 29, p. 136.

† The student should make his drawing from this description, marking the references as he proceeds.

A portico, composed of a series of columns supporting a pediment, and standing on a base to which we ascend by a flight of steps, being furnished with a plan and elevation of the same, would be as easy to draw in perspective as the example we have just given. Although it is necessary to be acquainted with rules by which even the most minute part of a structure can be drawn in perspective, it would be a most tedious process to find all the points required for drawing the curves of mouldings and the intricacies of ornament introduced in architectural representations; it is generally found sufficient to mark a certain number of leading points, and draw the intermediate lines by hand; practice enables architectural draftsmen to draw capitals of columns, ornamental friezes, &c. with great accuracy, from determining a comparatively few points. Whatever may be the forms of the component parts of a building, such as the base, shaft, and capital of its columns, or the extent of the projections of any parts of a structure, the principles on which they may be represented in perspective are contained in the directions given for drawing our last figure (32).

CHAPTER VII.

Having given to the full extent of our limits practical examples for drawing in perspective the forms of various figures and their combinations from different points of view, we will make a few observations on the choice of position for the spectator, relative to the objects to be represented in perspective. The important place the plane of delineation holds, as a feature in perspective drawing, must by this time be fully appreciated by the student; it is an imaginary plane, but in the preparatory steps towards making a perspective drawing it is treated as a reality, being made to intercept the rays of light in their passage from the original object to the eye. The rays of light being understood to proceed from every part of an object in straight lines to a point, the rays proceeding from any rectangular plane to this point would form a pyramid of rays; and from any circular plane they would form a cone; any section of this pyramid made parallel to the plane from whence the rays proceed, would present the same form as the plane itself, larger or smaller according to the distance from it the section is made, and a section of the cone of rays, parallel to the base of the cone, would present the figure of a circle larger or smaller according to its distance from it. If the section of either the pyramid or cone of rays is made in a direction not parallel to the planes from which they proceed, the sections would present a different form. This may be familiarly illustrated by the figure of a sugar-loaf, which is made in the form of a cone; if this is cut in any part in a direction parallel to the base, the section will be a circle, no matter how near to or far from the base; but if cut through in any direction not parallel to the base, the section would not present the form of a circle. In Fig. 15, if a cube stood over the square D, the rays of light proceeding from the front face of it to the eye of the spectator would form a pyramid of rays, and the section of this pyramid made by the plane of delineation, this being parallel to the plane of the base of the pyramid, the square figure is shown by the section; but if the direction of the plane of delineation were changed, the figure produced by the section of the pyramid would not be square; this would be equally the case were the direction of the base of the plane of delineation changed, or if the base remain on the same line, if it were inclined so as to be at any angle but a right angle with the ground plane.* It must be evident, then, that the position of this plane is of great importance, and in consequence some rule for determining it necessary.

Fig. 33.

If the plan of an object, as A (Fig. 33), were given, and the position of the spectator at B only, the student, notwithstanding he may have paid great attention to all the preceding diagrams, would find himself in some difficulty to draw the object in perspective *by rule*, the mere position of the object and spectator not affording sufficient data on which to commence operations; there is required in addition to these, either the direction in which the object is viewed, or the position of the plane of delineation, the one depending entirely on the other. A spectator placed in any open situation, by turning himself about, can see objects in all directions; but when looking at any object with a view to making a perspective representation of it, the direction of the eye must not be changed; any change in the direction of vision producing an apparent change of form in the object at which we are looking. In Fig. 34 we have, in addition to A and B in Fig. 33, drawn a line to show the direction in which we are looking at the object, viz. from B to *a*. In all our preceding diagrams we have given the object, the station of the spectator, and the position of the plane of delineation, and wherever the position of the point of sight has been required, it has been found by drawing a line from the station of the spectator perpendicularly to the plane of delineation; but here the positions of the object and spectator are given with the direction of vision, and the position of the plane of delineation is to be determined from these. Knowing that the forms of objects perpendicularly opposite the eye always present their real form, and that a section of the rays conveying the image only presents the real form when made parallel to the plane from which they proceed, it follows that the plane of delineation which makes the section of the rays on which the representation depends, must be parallel to those planes that present their original form to the eye, in order to arrive at a correct representation of the object. The plane of delineation then, it will be understood, is always placed perpendicular to an imaginary straight line proceeding from the eye of the spectator to the original objects, which is what we term the *direction* of vision; instead, therefore, of drawing, as in preceding examples, the direction of vision from the station of the spectator perpendicularly to the plane of delineation, we must, in drawing from any object, first mark the situation of it, as at A (Fig. 34), then the position of the spectator at B, with the direction of vision B *a*, and at right angles with the line B *a* the base

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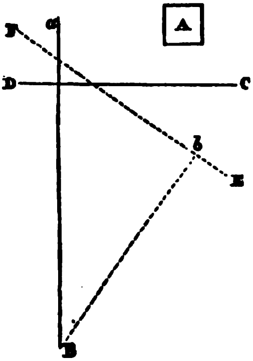
* In many works, figures are introduced, showing the change of form in the representation of objects by varying the direction of the plane of delineation, placing several planes of delineation between the object and spectator in different directions, and showing the variety of forms they assume on the different planes. Such figures here would be irrelevant to our purpose, which is only to point out how the position of this plane is to be determined, so as to produce proper perspective drawings, and not distortions.

Fig. 34.



line of the plane of delineation C D; the distance at which the plane of delineation is placed between the spectator and object not having any influence on the form presented to the eye, but only affecting its size. The figure A, viewed from B, in the direction B *a*, would be represented in parallel perspective, the vanishing point being the point of sight.

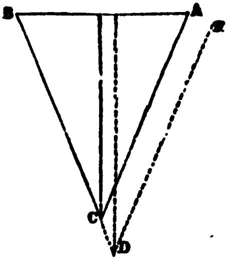
On the same figure (34), the positions of the spectator and original object remain the same, but the direction of vision is changed from B to *a* to from B to *b*, shown by dotted lines, and the base of the plane of delineation E F drawn at right angles with it. The importance of determining the direction of vision must here be instantly apparent; the original object viewed in this direction (B *b*) must necessarily be represented in oblique perspective. The representation of the figure A, viewed in the direction B *a*, would be similar to the square D, Fig. 22; the representation viewed in the direction B *b*, would be as the square A, Fig. 23. These observations are intended to impress on the mind of the student the necessity for keeping, when he has once fixed his position, and the direction in which he has determined to take his view, this position always the same, never turning his head either to the right or to the left; which brings us to another important question, viz. in order to draw a more or less extended representation, what the distance of the spectator should be from the object to be delineated.

In looking at any object, however limited the distance from the eye, we not only see the point that is immediately opposite, but some distance from this point both above, below, and on either side; and the further the object is removed from the eye, the greater extent of surface becomes visible. This may be made manifest by standing before the door of a house, and looking in a direction perpendicular to the plane of the door, placing the eye quite close to it; a very small portion of it will be visible; but keeping the eye in the same direction, and taking a step or two backward, the whole of the door becomes visible; by retreating a few steps further.

we see the windows situated over and on the sides of the door; and by going still further back, if in a wide street, the whole of the house, or two or three, may be visible: but as we cannot retire further back than the houses on the opposite side of the road, to represent the side of a street in parallel perspective, a very limited portion only could be drawn, and the extent that could be seen on either side of the point opposite the eye would depend on the width of the street. In an open situation we are enabled, by turning round, to see every object for miles distant; but remaining stationary, and looking in one steady direction, there must be some limit to the extent we see, both to the right and left; for if we turn the head to the right, we see an additional extent of country on that side, and lose sight of a portion on the other; and the reverse will be the case if we turn the head to the left. It is therefore requisite to determine the extent we may represent to the right and left of the direction of vision, whatever may be the original objects of the perspective drawing we may have to execute. It is difficult, in fixing this limit, to say precisely what it should be—writers differing much on the subject—but the most agreeable perspective representations are generally considered to be produced by fixing the angle of vision at from forty-five to fifty degrees; some extend it ten degrees beyond this, and in some cases this is admissible; but as a general criterion, from forty-five to fifty will be found most advantageous. In taking views from nature, and more particularly street views, the position of the point of sight is rarely chosen in the centre of the paper or canvas, but on one side, and for the most part nearer the ground line than the top of the picture; the student must understand that the centre of the picture, that is, the centre of the canvas or paper on which a picture is drawn, is only the *perspective* centre when the point of sight comes on this point; the point of sight, wherever it falls, being the perspective centre of the picture. In looking at any large representation, either landscape or architectural, the general effect is greatly enhanced by standing from the picture the relative distance the artist was supposed to stand from his subject, with the eye opposite the point of sight; in very large subjects, the perspective does not appear satisfactory to the eye if this is not attended to. A striking example of this may be seen at any time at a theatre; for as it is clear from what has been said, that there can only be one point of sight in a picture, there can be but one situation in the theatre where the representation can be perfectly satisfactory, which situation must be opposite the spot where the painter has fixed his point of sight.

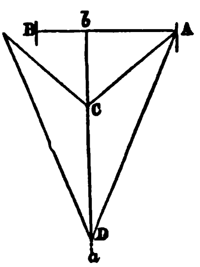
In order to get the full extent of view in a picture embraced in the angle of vision, whatever that angle may be, it is necessary that the point of sight be exactly midway between the two sides of the picture. Though this position is perfectly admissible, so far as regards correctness, it does not produce so agreeable an impression as when placed on one side; when nearer to one side than the other, the whole extent embraced in the angle of vision cannot be introduced in the picture; this will be understood by the annexed diagram, in which suppose A B to be the base of the plane of delineation, which will also represent the width of the picture, and C the position the angle of vision would be, as B C A and the picture would embrace the whole extent that could be seen; but if D were the position of the spectator, A B remaining the same, only a part of the extent visible on one side of the direction of vision would come into the representation.

Fig. 35.



The student is intended to understand from the foregoing observations in this chapter, that in his preparations for commencing a perspective drawing, either from nature or from plans and elevations, he must not imagine he can fix his station-point at random, at any distance from the objects, draw a line anywhere to represent the plane of delineation, and then proceed according to the rules given for making perspective representations in the diagrams from Figs. 15 to 32, and produce an effect that will be either pleasing or accurate; but that in the relative positions of the spectator, plane of delineation, and original objects, the arrangement should be such as will produce a representation similar to what we really can see from some fixed point, if drawing from nature, or that we know might be seen, if drawing from plans and elevations, or from description, which the directions here given will enable him to do. Thus, supposing a range of objects occupying a lateral extent of from A to B, Fig. 35, and the direction of vision as the line *a b*, the station of the spectator must be somewhere on that line. Suppose any one not acquainted with the limit of vision on each side of the line *a b*, Fig. 36, they might fix the station at C, which would be a position where it would be necessary to turn the head from side to side, it being impossible in one view to see so large an extent as this angle embraces; the lines, it is true, may be drawn according to the directions contained in the various problems and diagrams we have introduced, but the representation would have an extremely bad effect, no perspective representation ever being satisfactory to the eye but such as the original objects would present in one single view, without shifting the direction in which we look at them. Whatever the angle of vision determined on,—say, for instance, an angle of fifty degrees,—a point D on the line *a b* must be found, from which a line drawn to A will form an angle of twenty-five degrees with the line *a b*; a line anywhere across this line *a b*, at right angles with it, may be

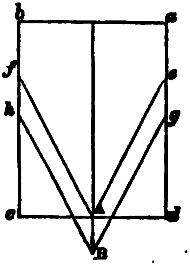
Fig. 36.



drawn for the base of the plane of delineation, the distance from the spectator to be regulated according to the size of the representation.

The knowledge of how to place the relative positions of original objects, plane of delineation, and station of the spectator, from a plan or description, is particularly serviceable in drawing architectural views in confined situations, such as small quadrangles, interiors of rooms, &c. By taking an imaginary position further back than the confined space a small quadrangle would allow you to take, a representation may be made that shall be perfectly satisfactory to the eye, give a faithful idea of the place it represents, and yet no position on the spot exist from which such a view can be seen. In crowded cities the effect intended to be produced by architects in looking at large buildings is completely lost, no situation existing so as to get a general view of the whole structure. St. Paul's Cathedral is an instance of this; the houses being crowded so thickly around it, no position is to be found by which the grand effect so imposing a building must present as a whole can be seen; the situation where the grandest impression this magnificent structure produces, is perhaps from Watling-street. A knowledge of perspective, the student ought now to understand, would enable a draftsman, with a plan and elevations of St. Paul's, to fix an imaginary station from which a perspective representation might be made, giving a just idea of how it would look from such a position, though no real position can be found that affords such an uninterrupted view in the vicinity of the building itself. In narrow streets, the general effect of large buildings is lost, and in making topographical drawings, unless the station of the spectator is assumed, the perspective is disagreeably sudden; in many instances, no position can be chosen from which the whole extent of the building can be seen without shifting the position of the eye. Artists are frequently excessively worried by the demands of their employers, who, completely ignorant of the principles of perspective, are frequently requesting the draftsman to furnish them with topographical views that it is impossible to excute. We will here introduce one more diagram, in order to show how an imaginary station is to be taken, that shall produce a satisfactory representation, though no position actually exists from which the original objects can be so seen in one direct view. Let *a b c d* represent the plan of some small quadrangle, such as is frequently met with in cloisters of old monastic buildings, and suppose the spectator at the point marked A, his back to the end *c d*, the greatest distance he can possibly get from the end *a b*. It will be understood how very little of the sides could be seen from this position, only from *a* to *e* and from *b* to *f*, though we have made the angle of vision to the extent of sixty degrees; but supposing we had a plan of the three sides of the quadrangle with their elevations, we could readily imagine the spectator to be situated at B, and proceed as if the quadrangle were viewed from that point, by which as much of the sides as from *a* to *g* and *b* to *h* would be represented; and by taking an imaginary station still further back, the whole of the sides of the quadrangle might be represented, and still produce an effect as if drawn from nature. Frequently, in subjects of this kind, one side contains much more interest in its architectural detail than the other; in such case the artist should take his station nearer to the side with the less interest, by which means he will have the opportunity of displaying to greater advantage the beauties of the other.

Fig. 37.



We have now, we sincerely trust, succeeded in carrying out the intention of this treatise, by leading the pupil by almost imperceptible degrees to understand the principles on which perspective representations are made, and have furnished ample directions to enable him to execute perspective drawings himself. In our earnest endeavour to make the whole proceedings perfectly intelligible, we have deviated from the general course of works on this subject; and that of which the knowledge is essential before even a perspective drawing can be commenced, meaning the determination of the positions of the spectator and plane of delineation, we have left to the last chapter, under the conviction that it would be more perfectly understood at that stage. Throughout the whole work the endeavour has been to make one part bear upon another, without attending to any consecutive arrangement, so as at the conclusion the student should feel himself master of the whole. In taking leave of the reader, to make use of the simile in Mr. Weale's prospectus, the author trusts that the boat which it has been his province to provide for conveying the student to the ship of science will carry him safely on board.

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